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ABSTRACTS OF DISSERTATIONS AND MONOGRAPHS IN MICROFORM

UNIVERSITY MICROFILMS, INC. ANN ARBOR, MICHIGAN, 1960



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Vol. XVI (13) July 1955-June 1956 XVII (13) July 1956-June 1957 XVIII (7) July 1957-June 1958

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AGRICULTURE

AGRICULTURE, GENERAL

A PEDOLOGIC STUDY OF THE AURA SOIL

(L. C. Card No. Mic 60-1430)

William Horace Farley, Ph.D. Rutgers University, 1960

Major Professor: John C. F. Tedrow

The Aura, a red-yellow podzolic soil which was originally classed as Sassafras, has unique characteristics in that it has a very loose sandy surface, but at 18-24 inches the matrix becomes very hard, retarding root development. The objective was to determine the nature and origin of the soil and explain some pedologic processes operating in the profile.

The Aura soil is associated almost exclusively with the Bridgeton, a formation of Quaternary age in southern New Jersey. The formation consists of a high clay-gravel mixture with the surface having a high silt and sand content. In order to establish some properties of the Aura soil, three profiles were selected, two of which represented the modal Aura, while a third showed all evidence of having a surficial mantle of wind-blown silts and sands.

Particle size distribution showed silt to be present in the upper mineral horizon between 36 and 90 per cent, but with depth it decreased to 2-5 per cent. Clay was present in much higher quantities at depth, one value being 40 per cent. Gravel also was in greater quantity in the lower horizons than at the surface.

Quartz-feldspar ratios were very wide in the surface horizons, with quartz at 98 per cent. However, in all three profiles, feldspar increased in the lower horizons, in one instance making up 73 per cent of the total light mineral suite. The feldspar was in an advanced stage of decomposition. Total heavy minerals were usually 3-5 per cent, but in one instance consisted of 14 per cent of the total mineral suite. All three profiles showed a rather uniform pattern, in the heavy mineral suites, not only with depth but between the profiles. Assigning the total heavy minerals a value of 100 per cent, ilmenite was 70-80 per cent, with leucoxene up to 18 per cent and zircon up to 10 per cent. There were small quantities of rutile, staurolite, tourmaline, sillimanite, and chloritoid.

Clay minerals were determined by x-ray techniques, DTA, and electron microscopy. Clay minerals in the upper horizons consist of micaceous materials at the surface, largely altered to a 14A° mineral corresponding to vermiculite. There were also small quantities of kaolinite present. At depth, however, the clay minerals consist almost exclusively of kaolinite and gibbsite. Small quantities of clay-size quartz are present throughout the profiles.

The distribution of fossils was studied throughout the profile and their character and distribution aided in establishing that some of the surficial materials were wind-blown.

Of the three profiles studied, one showed all indications of being influenced by aeolian activity, while the other two profiles were somewhat influenced by wind activity, the source of the material probably being from the same formation.

Both the laterization and podzolization appear to be operating on the profile presently with the latter process the dominating one, whereas in the past the former process predominate.

Microfilm \$2.50; Xerox \$4.00. 71 pages.

ANNUAL RINGS IN BIG SAGEBRUSH, ARTEMISIA TRIDENTATA.

(L. C. Card No. Mic 60-1585)

Charles Wesley Ferguson, Ph.D. University of Arizona, 1960

A collection of approximately 700 stem sections of big sagebrush Artemisia tridentata Nutt., from seven western states and Lower California, Mexico, has shown that this shrubby plant has the same ring character as do many forest trees.

This study has shown that big sagebrush produces a growth ring that is sensitive to changes in annual precipitation and in some areas reaches an age of slightly more than 200 years. The ring chronologies of big sagebrush show essentially the same pattern as adjacent tree-ring chronologies. At lower altitudes and southern latitudes false annual rings are occasionally formed by an extra layer of interxylary cork produced when growth is interrupted.

Because big sagebrush does have a definite annual ring, the rings can be counted to determine the age of any given plant or plant community. The oldest plants found indicate the maximum age reached by the species in that area; or they may indicate the time that has elapsed since some catastrophe such as fire, plowing, or flooding had occurred. The use of shrubs in this way thus provides an avenue for climatic and ecologic interpretation outside of the forested areas.

Microfilm \$2.50; Xerox \$8.60. 188 pages.

AN EVALUATION OF THE CRITICAL PERIOD AND THE EFFECTS OF WEED COMPETITION ON CORN AND OATS

(L. C. Card No. Mic 60-1441)

Ming-Yu Li, Ph.D. Rutgers University, 1960

Major Professors: Dr. W. F. Meggitt Dr. R. J. Aldrich

Significant progress has been made in the field of weed control during the last decade. Many new chemicals and new methods of applying these chemicals have been developed in this period. However, little fundamental information has been obtained on weed competition. For herbicides and cultural practices to be used most effectively in controlling weeds, basic information concerning weed competition is most urgently needed.

Emphasis of the present study was placed on (1) the evaluation of relationships between stages of crop development and damage by weeds, (2) the relative importance of competition for nutrient elements, (3) the possibility of counteracting weed competition in crops by increasing the rate of fertilization, (4) the study of the optimum weed-free band-width needed in row crops to eliminate weed competition, and (5) the comparison between the effects of pre- and post-emergence patterns of weed removal. The data were obtained from laboratory and field tests conducted at the New Jersey Agricultural Experiment Station, Néw Brunswick, New Jersey, during the years 1956, 1957, and 1958.

Allowing weeds to grow longer than one week in oats and two weeks in corn resulted in a loss of yield under some conditions.

Oats when competing with weeds produced less grain yield, less dry matter, fewer tillers, fewer seeds per panicle and had a lower content of nitrogen and potassium than those free from weed competition. Reduction of grain yield in oats was associated with a reduction in number of tillers under the present experimental conditions.

Increase in fertility level raised both yield and nitrogen content of the weedy oats to or above the level of the clean crop receiving no fertilizer.

A 12-inch weed-free band over the corn row did not offset the effects of weed competition.

Percent nitrogen in corn plants was lower when competition was longer than three weeks after emergence. The content of phosphorus, potassium and calcium was also affected by weed competition in some cases but not always in the same manner.

Results indicate that it is possible to counteract weed competition in corn by an increase in the level of fertilization under conditions where water is not limiting.

The significant difference found between the pre- and post-emergence patterns of weed removal serves to emphasize the importance of controlling weeds before they emerge.

Weeds capable of making rapid growth during the early stages of crop development depressed crop yields to a greater extent than those later in the season. Weeds competed strongly with corn and oats for nutrients. The greater content of N, P, K, and Ca in weeds generally occurred during the first two to three weeks subsequent to the emergence of the crop.

Corn and oats maintained weed-free for the entire season, yielded more and showed a higher nitrogen content than when weeds were allowed to grow at any time or in any pattern during the season.

Microfilm \$2.50; Xerox \$7.80. 166 pages.

THE AGRICULTURAL UTILIZATION OF LINSEED MEAL PRODUCTS

(L. C. Card No. Mic 60-1444)

Paul Garland Moe, Ph.D. Rutgers University, 1960

Major Professor: S. J. Toth

Linseed meal and linseed meal hulls, a product obtained by removing approximately half the protein from the whole linseed meal, were studied for their use as soil additives. Analysis of the products indicated that their primary value lay in their nitrogen content, about six percent nitrogen in the linseed meal, and about three percent nitrogen in the linseed meal hulls. There was also a possibility that due to their relatively high content of polyuronides, about twelve percent in both products, they might be of value as soil conditioning agents.

An incubation study indicated that the nitrogen in linseed meal was as readily mineralized as that in ammonium sulfate after four weeks incubation at 28° C. It also showed that although the linseed meal products did cause a significant improvement in the stability of soil aggregates, the effects were of short duration, lasting only about six weeks.

A series of experiments were conducted in the green-house, in out-of-door cylinders, and on field and turf plots to compare the availability of the nitrogen in the linseed meal products with that of several commonly used nitrogen sources, both organic and inorganic. The nitrogen in the linseed meal products was found to be slightly less available than that of such nitrogen sources as urea and ammonium sulfate, but just as, or more available than that of any comparable organic nitrogen source, such as Milorganite. In general, the nitrogen in linseed meal hulls was shown to be less readily available than that in the whole linseed meal, but it was more available than that in any comparable organic nitrogen source, such as Bovung.

Approximately the same results were obtained with all test crops studied, which included sudan grass, snap beans, rye, white potatoes, sweet potatoes, sweet peppers, sweet corn, and lawn grass seed mixture; and on all of the soil types tested, which included Nixon sandy loam, Penn silt loam, Collington sand, Lakewood sand, and Sassafras loam. The linseed meal products gave the best response on turf plots on Lakewood sand at the Pine Valley Golf Club. Here the linseed meal products were compared with ammonium sulfate, urea, urea formaldehyde, asphalt resin, 15-5-5 lawn fertilizer, Milorganite, and cocoa residue. One application of linseed meal made at the beginning of the season gave a better nitrogen response than any of the other products tested throughout the season.

A series of experiments was also conducted to compare

the effects of the linseed meal products with the effects of Krilium-186 on soil aggregation. It was found that although the linseed meal products produced yield increases equivalent to those obtained with Krilium-186 the first year, soil samples taken at the end of the season indicated that the linseed meal products did not produce a continuing effect on soil structure as did Krilium-186.

On the basis of these experiments it was concluded that the linseed meal products were most valuable as organic nitrogen sources, particularly as lawn or turf fertilizers where a slow, steadily available nitrogen source is desirable. At the rates at which they would normally be applied as nitrogen fertilizers, one to two tons per acre, any soil conditioning effects attributed to the linseed meal products would be only temporary and dependent upon environmental conditions such as temperature and moisture.

Microfilm \$2.50; Xerox \$5.40. 107 pages.

THE EFFECTS OF CERTAIN ORCHARD
CHEMICAL SPRAYS ON INSECTS AND MITE
POPULATIONS AND A SURVEY OF PREDACEOUS
MITES BELONGING TO THE GENUS
TYPHLODROMUS (PHYTOSEIIDAE) IN NEW JERSEY

(L. C. Card No. Mic 60-1453) Harold Balfour Specht, Ph.D.

Rutgers University, 1960

Major Professor: Bryley F. Driggers

In recent years certain apple pests formerly of minor importance such as orchard mites and red banded leaf roller have become more troublesome. Increased pest populations have been attributed to the toxic effect of DDT on the natural enemies of some pests, the reduced usage of lead arsenate and mineral oil that successfully prevented pest increases, and the development of resistant strains of orchard pests to toxic chemicals. Investigations were carried on during 1957 and 1958 to determine the effects of several apply spray schedules on the insect and mite populations in New Jersey orchards. A survey was made of the predaceous mites in the genus Typhlodromus (Phytoseiidae) found on apple and other plants in and near orchards.

Codling moth, <u>Carpocapsa</u> <u>pomonella</u> (L.), damaged a high percentage of the apples in orchards treated with lead arsenate or nicotine bentonite, as well as in orchards receiving no spray at all. DDT and ryania spray schedules controlled codling moth very well although under the latter program a few apples were scarred.

Plum curculio, <u>Conotrachelus nenuphar</u> (Hbst.), was poorly controlled with lead arsenate sprays; dieldrin and the phosphate insecticides that effectively controlled plum curculio eliminated the predaceous orchard fauna.

Rosy apple aphid, Anuraphis roseus Baker, caused considerable injury where no aphicide was applied.

Green fruitworm, Lithophane antennata (Wlk.), and redbanded leaf roller, Argyrotaenia velutinana (Wlk.), were insignificant pests in the orchards studied.

European red mite, Panonychus ulmi Koch, was infrequently found in unsprayed orchards.

The principal predators in these orchards were the

mites Typhlodromus spp. and Mediolata spp., although other predatory arthropods were present in small numbers.

Ryania-sprayed apple trees in south New Jersey, following a history of DDT sprays in previous years, at first maintained a fairly high European red mite population until large numbers of arthropod predators (Stethorus, Orius, Chrysopidae and thrips) reduced the populations to a low level.

Typhlodromus spp. and Mediolata spp. maintained the phytophagous mites at a low level. In north New Jersey the same arthropod predators did not increase sufficiently to reduce the European red mite before overwintering eggs were deposited.

European red mite on trees sprayed with fixed nicotine or with lead arsenate in central New Jersey increased to considerable numbers by the end of August and then were reduced to very small populations by the end of October due to the activities of predaceous insects followed by the predaceous mites.

DDT-sprayed trees received several acaricide sprays, which caused large fluctuations in the European red mite populations. Where the last acaricide of the season was applied early, large overwintering populations of European red mite eggs resulted, but if the acaricide was applied late, few overwintering eggs were deposited.

In the survey of <u>Typhlodromus</u> spp., 16 species were collected from various plants, usually in association with phytophagous mites. Thirteen of these species were found on apple trees.

T. (Typhlodromus) pomi (Parrott) was the only phytoseiid found on most non-sprayed apple trees. Following cessation of DDT sprays, T. (Amblyseius) fallacis Gar. was the first species to be found on apple trees; later, an influx of several different species occurred. After European red mites became scarce due to predation, the typhlodromid populations consisted mainly of T. (T.) pomi.

T. (A.) fallacis Gar. was the most commonly found typhlodromid on all surveyed plants other than non-sprayed apple trees. Other species included: T. (A.) finlandicus (Oud.); T. (A.) amicus Chant; T. (A.) sp., near amicus Chant; T. (A.) sp., near cucumeris Oud.; T. (A.) sp., near masseei Nesb.; T. (A.) okanagensis Chant; T. (A.) mexicanus (Gar.); T. (A.) guatemalensis Chant; T. (T.) sp., near rhenanus (Oud.); T. (T.) conspicuus (Gar.); T. (T.) longipilus Nesb.; T. (T.) pyri Scheuten; T. (T.) pomi (Parrott); and T. (T.) flumenis (Chant).

None of the species listed were confined solely to apple. T. (A.) guatemalensis and T. (T.) flumenis were not found on apple in New Jersey; the former was recorded from pine, and the latter from pine and red cedar. One specimen of T. (A.) okanagensis was taken from burdock.

Microfilm \$2.50; Xerox \$8.00. 172 pages.

AGRICULTURE, ANIMAL CULTURE

GENETIC, ENVIRONMENTAL AND RESIDUAL MATERNAL INFLUENCES ON COW PRODUCTIVITY AND GROWTH OF CALVES.

(L. C. Card No. Mic 60-482)

Robert Luciano C de Baca, Ph.D. Oregon State College, 1960

Major Professor: Ralph Bogart

A study was conducted on 417 heifers and 390 steers which were progeny of 250 dams and 165 granddams. The calves were born and raised in the years 1947 through 1956 on the Squaw-Butte Harney Experiment Station at Burns. Oregon.

Least squares analyses were employed to study the extent of genetic, environmental, and residual maternal influences on growth from birth through long-yearling age. The growth traits studied were: birth weight, weaning weight adjusted to 225 days, yearling weight adjusted to 385 days, long-yearling weight adjusted to 505 days, and all possible combinations of gains. Environmental effects considered in the analysis were: years, age of dam, whether a cow raised or did not raise a calf in the previous year, age of dam at first calving, season of birth, plane of winter nutrition, and age of granddam. Separate analyses of environmental effects were conducted for heifers and steers. The data for seven traits were adjusted for the environmental effects and sexes were combined by multiplicative adjustment of heifer data to steer equivalent. Steers exceeded heifers in the various growth traits by the following percentages: birth weight, 6.28; weaning weight, 5.16; yearling weight, 3.73; long-yearling weight, 3.83; suckling gain, 4.74; yearling gain, 3.25; and long-yearling gain 3.51.

Estimates of repeatability of cow productivity in the various traits were: birth weight, .15; weaning weight, .33; yearling weight, .31; long-yearling weight, .16; suckling gain, .34; yearling gain, .23; and long-yearling gain, .16. The methods employed did not identify influences which can be definitely attributed to permanent residual maternal sources.

Animals which in one period endure a restriction in growth, due to environmental influences, tend to compensate for the restrictions in the next period. The compensations for various environmental influences are shown to be measureably independent, and are directly related to the amount of deprivation in the previous phase. Compensations are offset in subsequent growth periods through reversed but incomplete compensation. The discrepancies in repeatability estimates in the post-weaning phases are attributed to compensatory growth.

Age of dam influences were apparent in all pre- and post-weaning growth phases. Cows increase in productivity until four years of age, maintain a plateau of production until eight years of age, then decline in production. Additive correction factors for adjusting weaning weights of calves to mature-age-of-dam equivalent were: for steers; 25, 10, 7 and 15 pounds for calves from 2-, 3-, 9- and 10-year-old cows; for heifers; 30, 20 and 10 pounds for calves from 2-, 3- and 10-year-old cows.

Season of birth influences were significant for birth weights and post-weaning traits. It is recommended that

breeding seasons be shortened to two or three heat periods to reduce this effect.

The effects of age of dam at first calving on the growth of calves as well as the effects of whether or not a cow raised a calf in the previous year were insufficiently consistent to be conclusive.

Selection of calves with heavy weaning weights should lead to improvement in subsequent growth rates. Compensatory growth phenomena obscure genetic potential in post-weaning growth under non-uniform environmental conditions.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

THE EFFECT OF B-VITAMINS AND ANTIBIOTICS ON PROTEIN UTILIZATION IN GROWING-FATTENING SWINE

(L. C. Card No. Mic 60-990)

Raymond Alphonse George De Pape, Ph.D. The University of Wisconsin, 1960

Supervisors: Professor Robert H. Grummer Professor Paul H. Phillips

Numerous studies have demonstrated that rate of gain and feed efficiency have been enhanced by the supplementation of practical swine rations with antibiotics. Several groups of workers have suggested that antibiotics exert a "protein sparing" effect in swine. Practical rations supplemented with an antibiotic and containing 3 to 4% less protein than normally recommended have produced feed lot performance equal to or better than that on accepted protein levels. In some instances, the response to antibiotics has been enhanced in the presence of B-vitamins.

In this study two experiments were conducted with weanling pigs fed to market weight on corn-soybean meal-alfalfa basal rations containing 18 or 14% crude protein reduced to 14 and 10.5% when the experimental lots averaged 115 - 5 lbs. live weight.

In both experiments the average daily gains of the pigs fed the 18% ration were greater than on the 14% ration though the differences were not statistically significant. In the first experiment rate of growth was not significantly influenced by the addition of aureomycin, B-vitamins (riboflavin, niacin, pantothenic acid and B12), or the antibiotic in the presence of B-vitamins to the 18% protein ration. A growth rate equal to that observed on the 18% basal, with or without aureomycin, was obtained by the addition of aureomycin with or without B-vitamins to the 14% protein ration. This response was not statistically significant. B-vitamins supplementation was generally ineffective in improving feed lot performance in either study. In the second experiment the addition of aureomycin alone or in combination with B-vitamins significantly increased average daily gains and improved feed efficiency.

Level of dietary protein had a depressing effect on ration digestibility in the first experiment as the 14% rations were significantly more digestible than the high protein ration. This effect was not observed in the second experiment. Treatments within protein levels had no significant effect on ration digestibility in the first study, however supplementation of the 14% basal ration with

aureomycin significantly increased the digestibility in the second experiment. B-vitamin supplementation also increased digestibility of the ration.

The apparent digestibility of protein in the ration was not influenced favorably or otherwise as a result of protein level or treatments within protein levels in experiment 1, however, protein digestibility was significantly increased as a result of aureomycin supplementation of the low protein diet.

Nitrogen retention was not significantly influenced due to treatment in either study although the retention on the higher protein basal diet was greater than on the lower protein diet.

Since aureomycin supplementation of the 14% protein ration did not significantly enhance nitrogen retention and the other criteria required to prove "protein sparing" effect have not been met, the results of this investigation do not support the postulation of protein sparing action of aureomycin. Some possible indirect effects of antibiotics in swine nutrition are discussed.

Greater intestinal synthesis and fecal excretion of vitamin B_{12} resulted from the supplementation of the 14% protein ration with aureomycin alone or in the presence of B-vitamins, including vitamin B_{12} . The higher protein diet also induced greater vitamin B_{12} excretion while B-vitamins had no apparent effect on fecal vitamin B_{12} excretion of pigs.

Microfilm \$2.65; Xerox \$9.25. 201 pages.

STUDIES OF SOME ENTERITIDIES OF SWINE

(L. C. Card No. Mic 59-6266)

Harold Lowrey Hurst, Ph.D. Purdue University, 1956

Major Professor: L. P. Doyle

Transmission and etiology of so-called pig typhoid were studied over a period of approximately 18 months.

These studies were based on three different problem herds in which the disease prevailed. These herds were also observed for the progress and outcome of the troubles. One case concerned trouble in young pigs on a better than average farm, a second case concerned an outbreak in shoats on an average farm and the third case came from a group of nutrition experiment shoats which had been receiving approximately 200 mg. of bacitracin per pig per day.

Experiments I, II and III were conducted in the same order as the cases described in the previous paragraph. A total of 87 young swine of 2 days to several weeks of age were used in 16 transmission trials, 2 filtrate experiments, and 9 therapy trials. Exposure material for these experiments was obtained from affected swine from the 3 problem herds. Transmission to healthy swine by oral and contact exposure to infective material was successful in each instance. Subsequent transmission trials and other investigations were then conducted.

The disease was not transmissible with bacteria-free filtrates but unfiltered intestinal material caused the disease. These filtrate experiments were conducted in isolation facilities. It appeared that the causative agent was

not filterable. Further bacteriological examinations revealed that Salmonella organisms were frequently isolated from dead or moribund pigs. The bacteriology of Experiment I was carried further than of Experiment II and III. Numerous cultures were made from the animals of Experiment I. Preliminary investigation revealed that there was a preponderance of Salmonella organisms. Later 8 representative cultures obtained from various passages of the disease were sent to Dr. P. R. Edwards at the Enteric Bacteriology Laboratory, Communicable Disease Center, Chamblee, Georgia for authoritative identification. Seven of these cultures were identified as Salmonella typhimurium or a variety (Copenhagen) of that species and one culture was identified as S. anatum. When cultures of these microorganisms were fed to serologically negative shoats they sickened within 12 to 16 hours. Four weeks later these shoats had titers of 1:100 by the rapid plate test when their sera were tested with an unstandardized antigen made from cultures of S. typhimurium.

In each experiment the disease responded well to chemotherapy. Therapy trials with antibiotics, sulfonamides and combinations of antibiotics and sulfonamides were generally effective in controlling the disease and reducing death losses.

A histopathological study was made of the intestinal tracts of pigs from Experiment I, II and III. The most consistent lesions observed were diphtheritis, necrosis of the mucosa and lymphoid exhaustion. The lesions appeared to be closely similar in the various cases.

Microfilm \$2.50; Xerox \$5.80. 117 pages.

STUDIES ON THE EPIZOOTIOLOGY OF EASTERN EQUINE ENCEPHALOMYELITIS

(L. C. Card No. Mic 60-1492)

Lars Herman Karstad, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Robert P. Hanson

Available knowledge of the epizootiology of eastern equine encephalomyelitis does not altogether explain the continued survival of the virus within enzootic areas nor its means of spread during periodic epizootic extensions. The presently described studies were carried out in attempting to learn more about the mechanisms for overwinter survival of the virus, its means of transmission under enzootic and epizootic conditions and the arthropod and vertebrate hosts involved. Ideas derived from field observations were tested by laboratory experimentation; in this way permitting the study, under controlled laboratory conditions, of newly recognized hosts of the virus.

White Leghorn chicken embryos were used exclusively as indicator hosts for the isolation of virus from infected tissues and in tests for virus neutralizing antibodies in the blood of mammals and birds. Blood and serum was handled in two ways; either as fluid specimens kept frozen or refrigerated until tested, or as dried adsorbates on paper discs. In the latter form they required no refrigeration. Broth eluates from dried paper disc-adsorbed specimens were tested in the same way as fluid serum.

Three isolations of eastern equine encephalomyelitis

virus were made in examining 641 pools of insects containing 10,878 specimens. Two of these, from a pool of Aedes mitchellae and a pool of Culicoides not identified as to species, represent first isolations from these diptera. The third virus isolate was from Anopheles crucians. Eastern equine encephalomyelitis virus was also isolated from one pheasant, one turkey and from eight horses, in the course of processing 265 specimens of blood and tissues from mammals and birds of 29 species. The isolation of virus from the pheasant was made from a specimen of blood which had been dried on paper and held for 16 days at room temperature. Subsequent laboratory trials proved that eastern equine encephalomyelitis virus could remain viable for more than two weeks when maintained at room temperature in dried whole blood.

The serological survey revealed neutralizing antibodies to eastern equine encephalomyelitis virus in the blood of 249 of 817 individuals, representing 100 species of birds and mammals. Twenty-nine of these 100 species possessed antibodies to the virus. Subsequently, experimental infection studies in turkeys, in swine and in several species of wild birds and rodents confirmed the susceptibility of these species and demonstrated that in most cases infections were of short duration, were frequently clinically inapparent and usually resulted in the development of high levels of virus neutralizing antibody. Turkey poults were alone among the birds and mammals studied in developing levels of viremia of sufficient magnitude for efficient arthropod transmission. The other species studied, while fully susceptible to small quantities of virus given by routes simulating natural exposure, were judged unlikely sources of virus for epizootic spread of equine encephalomyelitis.

Histological and histochemical studies failed to determine the composition of certain granules found within the cytoplaasm of nerve cells of five species of wild birds infected with eastern equine encephalomyelitis. Such granules were not observed in comparable numbers of uninfected controls.

The information gained in these studies, while contributing to a better understanding of the epizootiology, confirms the existence of unknown mechanisms for the perpetuation of eastern equine encephalomyelitis.

Microfilm \$2.50; Xerox \$5.80. 119 pages.

THE INFLUENCE OF DIETHYLSTILBESTROL UPON NITROGEN RETENTION, DIGESTION, AND BODY FLUID BALANCE IN ANIMALS.

(L. C. Card No. Mic 60-1270)

Robert Lee Noble, Ph.D. Kansas State University, 1960

Investigations were conducted with the following objectives: (1) to study the effect of rumen contents from control lambs, lambs implanted with stilbestrol, and lambs fed stilbestrol in the diet of rats on growth rate and feed efficiency; (2) to study the effects of low levels of stilbestrol on the growth rate and feed efficiency of rats and pigs as monogastric animals; and (3) to determine the effect of stilbestrol on digestibility of certain ration components, apparent nitrogen retention, apparent water retention, and volume of certain body fluids of sheep in

metabolism-type studies under carefully controlled conditions. Evans blue (T-1824), sodium thiocyanate, and antipyrine were used in the determination of plasma, extracellular, and total body fluids, respectively. Interstitial and intracellular volumes were derived by differences.

The addition of 5 percent dried rumen contents from lambs fed stilbestrol to the diet of rats significantly decreased (P<0.05) the rate of gain in young rats. A slight decrease in feed intake was also noted.

Levels of 0.1 and 1.0 mcg. of stilbestrol per gram of diet significantly decreased growth in young rats by 15.8 and 55 percent, respectively. Feed intake was depressed by 11.6 and 34.8 percent. Feed efficiency was significantly decreased only at the higher level.

In further studies rats fed stilbestrol at levels of 0.1, 1.0, and 10 mcgs. per day, based on an assumed 15 gram feed intake, gained 3.2, 10.3, and 49.4 percent less than control rats, respectively. Feed efficiency was significantly lower only at the highest level. These data suggest that the depression in the growth of the rats fed the lower levels of stilbestrol is directly related to feed intake. The daily injection of 100 mcgs. of growth hormone into rats fed 10 mcgs. of stilbestrol did not alleviate the growth-depressing effect.

A low level of stilbestrol $(2\frac{1}{2} \text{ mcgs. per pound of ration})$ did not affect growth rate of fattening pigs. Feed efficiency was increased slightly with the pigs fed stilbestrol.

In metabolism studies with lambs stilbestrol did not significantly increase digestibility of dry matter, organic matter, or protein. Nitrogen retention was significantly increased the first 10 days but tended to decrease by consecutive 10-day periods. Apparent water retention was significantly increased (P<0.05) by 154 grams daily in the first trial and 194 grams daily in the second trial. Stilbestrol did not increase total body water or plasma water, but did increase extracellular water by 3 percent. This increase was significant (P<0.07). Since there was no difference in plasma volume, the difference was assumed to exist in interstitial fluid. It appears from these data that part of the increased liveweight gain of lambs is due to an increased retention of water in the interstitial fluid.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

SOME ASPECTS OF THE DYE BINDING OF MILK AND MILK POWDER PROTEINS

(L. C. Card No. Mic 60-1520)

Rupert Grant Seals, Ph.D. Washington State University, 1960

Supervisor: Dr. U. S. Ashworth

The purpose of this study was to determine the suitability of the acid dye Orange G (1-phenylazo-6,8-disodium sulfonic acid-2-naphthol) as a reagent for the determination of milk protein.

The stoichiometry of the milk protein-dye reaction was studied using isolated and redissolved casein, serum protein, and proteose-peptone. Alpha- and beta-casein solutions were also used. The stoichiometry of the protein-dye reaction is supported by (1) the linear relationship between the amount of dye precipitated Db and the amount

of protein \underline{P} , (2) the constant ratio between the dye binding capacities of the milk protein fractions and their content of lysine, arginine and histidine. (3) the fact that the reaction is independent of temperature changes in the range of $6-54^{\circ}C$.

A 0.2 M. citric acid buffer with an ionic strength of 0.11 and an initial pH of 1.9 is recommended for milk protein-dye binding. A pH of 1.2 was found not to be detrimental to the protein-dye reaction; whereas, pH values above 2.2 lowered the dye binding capacity.

The dialyzable constituents from a 30% reconstituted nonfat dry milk did not significantly affect the dye binding capacity when combined with casein in amounts covering the normal range of these constituents in milk. Specific studies with lactose, chloride, and calcium were carried out. Lactose did not alter the dye binding capacity of casein in the amounts studied. Chloride lowered the dye binding capacity in a linear manner up to 181 mg. Calcium as Ca(OH)2 increased the dye binding capacity of casein up to 0.03-0.05 M. and decreased it significantly above 0.07 M. The increase was explained in the light of Klotz's theory of intraionic competition in which the anionic groups on the protein bind the cationic groups thus reducing the number of cationic groups available for dye binding. The calcium in certain concentrations apparently releases these bonds. Aggregation of the protein under the influence of high calcium concentrations is the probable cause of the decrease in binding.

The dye binding capacities of the proteins in mg. of dye precipitated per mg. of protein were as follows:

Casein .190, serum protein .240, alpha-casein .190, beta-casein .174, proteose-peptone .151, total protein .187, fluid milk isoelectric casein free filtrates .198, spray dried milk isoelectric casein free filtrates .161, fluid milk sodium chloride casein free filtrates .0368, and spray dried milk sodium chloride casein free filtrates .0171.

The low dye binding capacities of the last two filtrates was due to the presence of the chloride ion in high concentrations.

A high correlation was found between the percentage protein as determined by the Kjeldahl method and free dye absorbancies. High correlation coefficients were also obtained for the binding of isoelectric casein free filtrates. Sodium chloride casein free filtrates yielded lower correlation coefficients.

The stoichiometry of the non-isolated milk proteins was good as shown by the high correlations obtained from plotting dye precipitated against protein.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

AGRICULTURE, FORESTRY & WILDLIFE

CERTAIN WOOD PROPERTIES OF SOUTHERN RED OAK (QUERCUS FALCATA MICHX.)
IN RELATION TO LOCATION WITHIN THE BOLE AND TO ENVIRONMENT

(L. C. Card No. Mic 60-1295)

John Robert Hamilton, Ph.D. North Carolina State College, 1960

Supervisor: James Samuel Bethel

Six southern red oak trees (Quercus falcata Michx.) were subjected to intensive laboratory analysis in order to determine how sixteen wood properties varied within the boles of individual trees. The characteristics examined were the physical properties--specific gravity, ring width, percentage of latewood, longitudinal shrinkage, radial shrinkage, and tangential shrinkage; the mechanical properties--side hardness and toughness; and the anatomical characteristics--fiber length, fiber tracheid length, earlywood vessel diameter, width of rays, and the percentage of the transverse surface in ray tissue, earlywood parenchymatous tissue, latewood parenchymatous tissue, and latewood fibrous tissue.

Data were collected for the preceding characteristics from each ten-year increment of two radii at 10 per cent intervals of total tree height. For this reason all of the data could be related to a position in the trees by the percentage of total height and age from the center. A preliminary graphical analysis indicated that a quadratic function was required to give an adequate mathematical description of the patterns assumed by the characteristics within the tree boles. As a result a polynomial equation in terms of height and age, their squares, and their cross product was computed for each wood property in each tree.

An analysis of these regressions indicated that all of the wood properties varied both horizontally and vertically within the individual tree boles. Depending on the property being considered, the degree of this within-tree variation differed. In addition to this within-tree variation which could be described by the polynomial equations, there was a certain amount of variation about the fitted regressions which apparently was a function of both the characteristic and the tree under consideration.

It was indicated that the patterns assumed by the wood properties were not constant in all six trees. There was more difference between trees for some wood properties than for others. Those properties that varied the least between trees were specific gravity, percentage of latewood, fiber length, the percentage of latewood fibrous tissue, earlywood vessel diameter, and width of rays.

The regression equations from the six trees were combined to provide an average mathematical expression for the response of the wood properties under consideration to the effect of height and age. More than 70 per cent of the variation in fiber length, fiber tracheid length, and vessel diameter was accounted for by the average regressions. In the cases of specific gravity, ring width, percentage of latewood, side hardness, toughness, and the percentage of latewood fibrous tissue, between 50 and 70 per cent of the variation was associated with the regression. There was less degree of association when the remaining wood properties were considered.

The original wood property data were subjected to further statistical analysis in order to develop prediction equations in terms of three easily measured wood properties (specific gravity, ring width, and percentage of latewood) for the remaining ones measured with more difficulty. Highly significant prediction equations were developed for all of the wood properties except the percentage of ray tissue and the three shrinkages.

The effect of environment on wood properties was examined by determining specific gravity, ring width, and percentage of latewood in increment cores extracted from trees growing in selected situations. The particular environments of interest were two geographic and climatic zones in the Piedmont Plateau, north and south aspects within each of these zones, and upper and lower topographic positions within each of the aspects. Supplemental data were obtained relative to various stand and soil characteristics.

None of the site characteristics were observed to have any major effect on the wood properties of southern red oak.

Microfilm \$3.15; Xerox \$11.05. 243 pages.

THE FACTORS AFFECTING THE BREEDING OF GAMBEL'S QUAIL LOPHORTYX GAMBELLI GAMBELLI GAMBEL IN ARIZONA

(L. C. Card No. Mic 60-1402)

Charles Roger Hungerford, Ph.D. University of Arizona, 1960

Supervisor: Dr. Robert R. Humphrey

Changes in environment that might be correlated with changes in Gambel's quail numbers were determined through an integrated study of the birds, their habitats, and climatic environments carried out during the period from 1953 through 1957.

Three basic habitats were studied: desert-shrub, desert-grassland, and chaparral. The effect of precipitation on quail food and cover in these habitats was studied by an analysis of the vegetation. The quail were studied in the field and laboratory to determine the effect of changes in climate and plant environment on breeding rate, food and cover use, moisture requirements, and survival. Postmortem examination of collected birds yielded information on vitamin A storage and the development of reproductive organs.

The amount of winter and spring rainfall was found to control the amount of spring ground cover in the desert areas studied. This green growth provided food sources for the quail which contained a stimulator resulting in a considerable increase in breeding rate during the wetter years. The stimulating factor derived from green plants was either carotene or an accompanying substance similarly assimilated, stored, and depleted.

Captive quail fed known levels of carotene and vitamin A were found to have reduced breeding success with the lower levels of these nutrients. The liver storage of vitamin A in these experimental birds was compared with the storage attained by wild quail during wet and dry years. It was concluded that Gambel's quail must have a liver

storage of vitamin A above 175 micrograms per gram of liver in order to breed. Good young production of wild birds was associated with a storage of twice this level.

The quail were found to be quite adaptable and capable of considerable change in food selection between study areas and at different seasons of the year. They were able to maintain body moisture on moisture-containing plants without using open water.

Breeding stimulus by the carotene consumed was concluded to be the limiting factor controlling quail numbers in Southern Arizona. Artificial production of plant carotene sources or the use of vitamin A pellets at critical periods was suggested for further experimentation. Future more intensive management may require such measures to maintain a high quail population for the ever-increasing number of hunters.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

AGRICULTURE, PLANT CULTURE

FORECASTING THE TIME OF ASPARAGUS HARVEST

(L. C. Card No. Mic 60-1423)

David Blumenfield, Ph.D. Rutgers University, 1960

Major Professor: Dr. Stuart B. LeCompte, Jr.

These studies were initiated to learn more about asparagus dormancy, asparagus growth, and methods of forecasting asparagus harvest.

A special method of forecasting the first cut of asparagus 4, 7, 10, or 21 days after the accumulation of a certain number of degree days was devised because the usual method of degree day forecast was no better than a calendar day forecast. A slight modification of the Arnold method was used to determine the base temperature of 16° F. In most years over a 15-year period this base temperature of 16° F. gave a better forecast of first asparagus cut than base temperatures of 48°, 40°, 33°, 30°, 24°, or 12° F., or than the growth unit method. A combination 16° and 48° F. base temperature gave the best forecast of first asparagus cut. The first cut of asparagus can be forecast as much as three weeks in advance with a fair degree of accuracy; however, the degree of accuracy increases with shorter forecasts. The base temperature and the method of forecasting which give the best results in actual forecasts over a long period of years should be used in degree day summations. The first heavy cut of asparagus was forecast most accurately as nine days after the first cut when each day had an average temperature of 51° F. or higher.

The asparagus crown gradually passed into a less active quiescent stage during the colder months of the nongrowing season and gradually became more active as the time of spear emergence approached. The maximum inactivity of the crowns occurred in January for the years 1957 and 1958. Cold storage at 31° F. or 34° F. for various periods of time failed to induce this less active quiescent stage to any extent.

The growth rate of the asparagus spear was proportional to temperature and to spear height. The relationship was almost entirely linear between mean temperatures of 45° F. and 75° F.; however, the relationship was curvilinear at the lower spear heights and temperatures. The terms for temperature and spear height in a linear additive model accounted for about 80% of the variation in daily growth rate for high, medium, and low producing male and female plants. A regression analysis of medium producing female plants showed that an increase of one centimeter in spear height was associated with an increase in daily growth rate of 0.35 centimeter; an increase in temperature of one degree Fahrenheit was associated with an increase of 0.31 centimeter in daily growth rate. Asparagus spears, unlike the organs of many other plants, grew more during the day than during the night under our conditions. These growth differences can be attributed at least partly to the temperature difference between the day and night. Bihourly growth rates varied from 0.1 cm. to 2.3 cm. for average bihourly temperatures between 53° F. Microfilm \$2.50; Xerox \$5.40. 108 pages.

INTERRELATIONSHIPS OF THE TRACE ELEMENTS ZINC, BORON, IRON, MANGANESE, AND COPPER ON THE GROWTH AND COMPOSITION OF CORN.

(L. C. Card No. Mic 60-1531)

Howard Dale Fuehring, Ph.D. The University of Nebraska, 1960

Adviser: Leon Chesnin

A study was made to determine the effects of varying levels of Zn, B, Fe, Mn, and Cu on the vegetative yield of corn grown in sand culture. Objectives of the experiment were: (1) to determine the presence and magnitude of interactions among trace elements on the growth and composition of corn; (2) to determine levels of Zn, B, Fe, Mn and Cu in nutrient solution resulting in the highest vegetative yields of corn under the experimental environment.

Five levels of each of the trace elements studied were applied in Hoagland and Arnon nutrient solutions. The levels of each of the trace elements were selected in a logarithmic relationship to cover the range of excess to deficiency. A central composite, rotatable design was used in order to permit calculations of response surfaces with a much smaller number of treatments than required with the use of a complete factorial design.

The regression equation for yield of dry matter was used to estimate the levels of each of the investigated trace elements required in the nutrient solution to obtain maximum vegetative yield of corn under the conditions of the experiment. The results obtained were 7.73 ppm. Zn, 0.185 ppm. B, 0.0045 ppm. Fe, 0.241 ppm. Mn and 0.0042 ppm. Cu. However, it was shown that a change in the level of any one of the variables resulted in changes in the required levels of other variables. Concentrations of the individual trace element variables in the plant as estimated from their respective regression equations with variables set at the above optimum levels for maximum yield of dry matter were 308 ppm. Zn, 19.5 ppm. B, 38.2 ppm. Fe, 49.0 ppm. Mn and 3.8 ppm. Cu.

The following ion pairs had a complementary effect on one another in regard to yield of corn tops: B-Fe, Zn-Mn, Mn-Cu, Zn-Fe, Zn-B and Zn-Cu. The B-Mn, Fe-Cu and B-Cu interactions were antagonistic in effect. The Fe-Mn interaction was both complementary and antagonistic in effect. None of the interactions had a significant effect at the 5% level on corn yield.

The Zn-Mn and Fe-Mn interactions had the greatest effect on Zn concentration in the corn plants. The critical level of Zn in corn plants was 100 ppm. indicating a high requirement of corn for Zn under the conditions of this experiment.

No definite critical level of B in the corn plants could be established. The range varied from 10 to 20 ppm. B depending on the levels of other trace elements. None of the interactions were significant at the 5% level.

When other trace elements were in balance the iron requirement of corn was low. However, a deficiency or toxicity level of another trace element increased the requirement for Fe. The Mn-Cu and Zn-Cu interactions had highly significant effects on the concentration of Fe in corn tops.

The Zn-Cu, Fe-Mn, Fe-Cu, and Zn-Fe interactions had highly significant effects on the concentration of Mn in corn tops. The critical level for Mn in corn varied between 50 and 75 ppm.

The Fe-Cu interaction had a highly significant effect on Cu concentration of corn plants. The critical level for Cu in corn plants varied from 3 to 5 ppm.

The P concentration of corn plants was greatly influenced by the level of Zn in solution. The concentrations of N, S, Ca, Mn and K were only moderately affected by levels of trace elements in solution.

In general, it was concluded that interactions among the trace elements Zn, B, Fe, Mn and Cu had considerable effect on the yield of dry matter and composition of corn. In particular, corn appeared to have a high requirement for Zn.

Microfilm \$2.50; Xerox \$7.80. 168 pages.

RELATIONS BETWEEN ION CONCENTRATION IN SOIL SOLUTIONS AND THE ABSORPTION OF PHOSPHATE BY PLANT ROOTS

(L. C. Card No. Mic 60-1289)

Vernal Henry Gledhill, Ph.D. North Carolina State College, 1959

Supervisor: Nathaniel Terry Coleman

New techniques for determining soil solution concentrations and for measuring rates of phosphate uptake by excised plant roots during short-term absorption periods were developed. The techniques were used to obtain information on the effects of soils, water content, and the nature and concentration of salts on phosphate uptake by plants, as well as on phosphate concentration in soil solutions. The results were compared to those obtained by more conventional nutrient-solution and greenhouse-growth methods.

A negative relationship was found between moisture content and phosphate uptake over short absorption periods. Phosphate uptake was largest from the drier soils. Data obtained over extended periods of time (eight hours) were confounded by changes in plant behavior due to root dehydration. An exponential relationship was found between soil solution concentration and phosphate uptake as measured by this technique.

Neutral salt effects on phosphate solubility and uptake from soils were investigated. Neutral salts were found to react differently in different soils. With a sandy Granville soil, there was general parallelism between salt effects on solubility and on plant uptake. The Cecil clay soil used was well buffered so far as solution concentration of phosphate was concerned, and salt effects on solubility and on uptake were quite small.

Parallel greenhouse experiments designed to study the effects of neutral salts on phosphate uptake by corn, using the same Granville soil employed in the root mat studies, gave entirely negative results. Salts uniformly decreased phosphate content slightly.

In nutrient solution investigations on the effect of nitrogen salts on phosphate uptake by corn seedlings, ammonianitrogen increased uptake more than did nitrate-nitrogen. The greatest influence of the ammonia was observed in translocation to tops at pH 5 and 6.

Transpiration was found to enhance phosphate uptake. Transpiration also increased phosphate translocation under conditions of an active ion uptake. A mechanism was sugtested for increased translocation of phosphate by the transpiration stream.

A method was described for maintenance during absorption studies of a constant pH and solution concentration of phosphate at levels commonly found in soil solutions. This was compared to the more conventional method of using high concentration rates as a buffer against pH and concentration changes. The results indicated that this new method was equally suitable for demonstrating pH effect on uptake and transport.

Maximum phosphate uptake was attained at pH 5. Uptake and translocation were consistently lowest at pH 7 over the range pH 4 to pH 7. Uptake rate at pH 4 showed a sharp decline after three hours' absorption. A sharply increased translocation was obtained at all pH levels after three hours' absorption.

The relationship between pH, mass flow, translocation, transpiration, and inhibition is discussed in light of the results obtained and recently published reports on ionic species and competitive inhibition in phosphate uptake.

Microfilm \$2.50; Xerox \$6.20. 126 pages.

THE EFFECT OF SOIL APPLICATION OF TRACE NUTRIENTS UPON PLANT YIELD AND UPTAKE OF APPLIED NUTRIENTS

(L. C. Card No. Mic 60-1435)

Everett Milton Jencks, Ph.D. Rutgers University, 1960

Major Professor: E. R. Purvis

A soluble trace nutrient salt mixture, Es-Min-El, produced by the Tennessee Corporation of Atlanta, Georgia, and its component salts were applied to crops on Coastal Plain soils in Gloucester County, New Jersey in 1955 and

Yield data were taken for peppers, sweet potatoes, peaches, alfalfa and corn. Chemical tests for the individual trace nutrients were made on leaves, and on grain in the case of corn.

Significant yield increases from Es-Min-El treatment was produced in only one of the nine tests made. Several single salt treatments produced significant yield increases whereas in the same tests, Es-Min-El, which supplied these nutrients at the same rate, had no effect.

The effect upon yield of a single trace nutrient salt application was not always associated with increased uptake of the applied nutrient, but was associated with increased uptake of one or more of the other applied trace nutrients. There was not always a proportionate increase in tissue content of the nutrients supplied by Es-Min-El with increased rate of application of this mixture. In several cases, treatment with the mixture at any rate had little influence on the trace nutrient content of the tissue.

The results indicate that applications of a trace nutrient mixture to soils thought to be low in content in one or more of the trace nutrients may or may not increase crop yield. Before such applications are made, a diagnosis of the particular soil to be treated should be made.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

LOSS AND UPTAKE OF NUTRIENTS IN COARSE TEXTURED IRRIGATED FOREST NURSERY SOILS

(L. C. Card No. Mic 60-1496)

Helmut Horst Krause, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor S. A. Wilde

Because of frequent cultivation, irrigation, enormous density of the crop, and especially because of the removal of both tops and roots of seedlings, forest nursery soils often require applications of fertilizers at rates far exceeding those used in farm practice. Under such conditions, the loss of fertilizer salts through leaching increases the cost of soil fertility maintenance, changes drastically the nutritional balance, and leads to the production of inferior planting stock. This study was conducted to determine the dynamics of nutrients as influenced by application of fertilizers, irrigation, and feeding of nursery stock.

Nitrogen, phosphorus, potassium, and calcium were applied in the form of either readily or slowly available fertilizers ahead of seeding, as fertilizer solutions for treatments of growing stock, and in combination with leguminous or non-leguminous green manure crops. Red pine, Pinus resinosa, was used as the test plant. The determination of the leaching losses and the uptake of nutrients was accomplished by periodic analyses of soils, plant tissues, and leachates collected by means of alundum tension lysimeters.

When nutrients were applied in the form of ammonium sulfate, potassium chloride and calcium monophosphate ahead of seeding, 70 to 90 percent of the nitrogen, about 17 percent of the potassium, and a large fraction of the exchangeable calcium and magnesium was leached from

the root zone during the first growing season. Phosphorus remained nearly immobile.

The loss of nutrients was considerably reduced by the use of slowly available fertilizers, including urea formal-dehyde, potassium metaphosphate and 20-mesh syenitic granite. The average net loss of nitrogen from urea formaldehyde was 35 percent; the maximum net loss of potassium was 6 percent.

The application of fertilizer solutions appreciably changed the picture of leaching losses. The average net loss of nitrogen varied from 10 to 20 percent, whereas the leaching of calcium and magnesium was nearly arrested. However, in treatments of 1-0 stock, as much as 20 percent of the potassium applied were lost through leaching.

Bentonite increased the retention capacity of the soil and reduced the losses of nitrogen, and bases.

The catch crop of oats proved to be efficient in the preservation of all major nutrients. Soybeans arrested the leaching during the period of their growth, but upon incorporation into the soil and subsequent decomposition, a large fraction of nitrogen and potassium was lost into the drainage water.

The uptake of nutrients and the rate of dry matter production was closely correlated with the stability of the nutrients in the soil.

An average stand of three year old red pine seedlings extracted from the soil the following amounts of nutrients on per acre basis: 222 pounds of nitrogen, 36 pounds of phosphorus, 92 pounds of potassium, 63 pounds of calcium, and 30 pounds of magnesium. Six to 9 percent of these amounts were utilized by the plants during the first growing season, 15 to 41 percent during the second, and 53 to 80 percent during the third growing season.

The results of the study have indicated that a certain fraction of applied nutrients is rendered temporarily unavailable to plants by chemical or biological fixation.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

AN EVALUATION OF HESSIAN FLY INCIDENCE AND DAMAGE IN WHEAT AS AFFECTED BY FERTILIZER TREATMENTS UNDER FIELD CONDITIONS

(L. C. Card No. Mic 59-5306)

Bede Nwoye Okigbo, Ph.D. Cornell University, 1959

Wheat fertilizer experiments were conducted on six important agricultural soils of western New York in 1956 and 1957. Observations on hessian fly infestation and damage were made with the following objectives:

- 1. To determine the incidence of hessian flies in wheat grown at varying levels of nitrogen fertilization.
- To evaluate the damage caused by this insect and consequently determine whether there is differential yield reduction in relation to nitrogen fertilizer levels.

PROCEDURE AND METHODS

The different rates of fertilizers in pounds of actual nutrients applied per acre were as follows:

Treatments	1956 N - P - K	1957 N - P - K
A	0-40-40	0- 0- 0
В	20-40-40	0-40-40
C	40-40-40	20-40-40
D	60-40-40	40-40-40
\mathbf{E}	40- 0- 0	40- 0- 0

The treatments were applied in early spring as top-dressings. Starter fertilizers applied in the fall of the previous year at planting time amounted to 250 pounds per acre of a 5-10-10 fertilizer. Observations were made in 10 locations in 1956 and 6 locations in 1957. The layout in each location was a 5 x 5 latin square with plot size of 6 x 20 feet. The wheat variety used was Genesee. Samples of from 300 to 400 plants were taken from each treatment in each location and observations were made on the number of infested culms, number of flaxseeds per infested culm, and grain and straw yields of infested and uninfested plants. Additional observations were made at Aurora in 1958 and the nutrient status of infested plants was studied.

Losses were based on the disparity between yields of infested and uninfested plants. The formula

$$\left[\Sigma I(\overline{X}_{N} - \overline{X}_{I}) + W_{L}\right]A$$

was used to estimate yield losses where Σ I represented the total number of infested plants per plot, W_L the grain yield of infested lodged plants, \overline{X}_N and \overline{X}_I the average weights in grams of uninfested and infested plants in each plot respectively, and A the acre factor for converting the plot yields recorded in grams into pounds or bushels per acre. For the straw losses and the losses attributed to incomplete filling of the grain of infested plants, W_L was dropped from the formula.

RESULTS AND CONCLUSIONS

Significant differences between treatments were observed with respect to the number and percentage of infested plants. The amount of infestation increased with increasing levels of nitrogen. The resulting losses closely followed the amount of infestation. Treatments E (40-0-0) and D (40-40-40) exhibited the highest infestation and yield losses. The lowest losses and infestation were observed in treatments B (0-40-40) and A (0-0-0) while treatment C (20-40-40) was intermediate in this respect. The percent infestation observed varied from 4 to 61, 4 to 17, and 21 to 35 percent in 1956, 1957, and 1958 respectively. The estimated grain losses observed in 1956, 1957, and 1958 were between 5 to 15, 0.6 to 9, and 2 to 2.4 bushels per acre respectively.

No definite relationship was found between insect infestation and soil reaction and/or drainage. Wheat fertilizer treatments which seemed to lack the expected response to nitrogen fertilization often did so because of differential hessian fly infestation and damage. In one location, treatment D (40-40-40) yielded 46.3 bushels of grain per acre while treatment E (40-0-0) yielded 48.9 bushels, but the estimated losses in yield due to hessian fly infestation were 9 bushels and 5 bushels per acre respectively.

Increases in nitrogen level resulted in similar increases in plant population and infestation. The significant linear correlation coefficients between plant population and infestation in 4 locations were 0.53, 0.74, 0.82 and 0.85. Similar correlation coefficients observed between

infestation and lodging in 4 locations were 0.83, 0.92, 0.93, and 0.94.

There were indications that the observed increases in infestation with increasing levels of nitrogen were due to the indirect effect of nitrogen on tillering rather than to the preference of plants grown at high nitrogen levels by adult female flies for oviposition.

Infested plants exhibited slightly higher percent phosphorus and potassium contents than uninfested plants, probably due to the lower dry weights exhibited by infested plants.

Microfilm \$3.10; Xerox \$10.80. 237 pages.

EFFECT OF DECOMPOSITION PRODUCTS FROM CERTAIN FORAGE CROPS ON TOBACCO SEED GERMINATION AND SEEDLING GROWTH

(L. C. Card No. Mic 60-1014)

Raojibhai Mangalbhai Patel, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor W. B. Ogden

Tobacco grown after certain crops shows injurious effects of the preceding crop, which in Wisconsin is commonly known as "sod effect." Greenhouse and laboratory studies were conducted to find out how and under what conditions toxic decomposition products from some crops are produced.

Timothy, orchardgrass, bromegrass, oats and ryewere grown in the greenhouse at 75-80°F temperature. Young, fresh plant materials were decomposed in a compost soil at 20% moisture. Leachates from the decomposition products were tested by the tobacco seed germination test for their toxicity. Timothy produced the most toxin, followed by orchardgrass and bromegrass; rye and oats were about equal. These plant materials, when decomposed in highly fertile tobacco soil of pH varying from 4.80 to 6.90 did not produce toxin. Liming an acid soil did not change soil environment for the production of toxin. The compost soil which produced toxin, and the other highly fertile tobacco soil which did not produce toxin, were sterilized in an autoclave. These soils when used for decomposition, produced no toxic effect.

The leachates obtained from decomposition of timothy in compost soil ranging from one to five weeks old were applied weekly to tobacco seedlings growing in sand culture with two different nutrient solutions. These showed two peaks of toxin production at two and five weeks.

Timothy sod soil in comparison with the compost soil reduced green weight of the tobacco plants produced in them in the greenhouse. Tobacco responded to fertilizer treatments in the compost soil, but not so in timothy sod.

Succulent fresh timothy tops were decomposed with distilled water in the proportion of 1:5 in the flasks at 27°C and 11°C temperature. High temperature decomposition products killed tobacco seedlings getting both nutrient solutions and also inhibited seed germination in petri dish test. Low temperature decomposition products produced beneficial effects on both tests. Potency of the toxin increased with the progress of the decomposition at the high temperature. The pH of the leachates decreased as the decomposition increased.

Evaluation of the toxin produced in timothy plant infusions in distilled water was made by tobacco seed germination and seedling test methods. The toxin was not selective in producing deleterious effects on the seedlings tested. The toxin was not removed by boiling just up to 100° C and by boiling and reducing to 1/2 its volume or by sterilizing in an autoclave for 30 minutes at 15 lbs. pressure, or by adjusting pH up to 7.00 by 1N sodium hydroxide. Treatment with activated charcoal and finely sieved highly fertile tobacco soils, or evaporating it to dryness, then redissolving and making it to the volume with distilled water removed toxic effect. Fractional distillation into four equal parts, gave progressive increase of the toxin in the fractions. Cation exchange resin did not remove toxin, while anion removed it from the toxic filtrate. The toxin was completely removed from the solution by dialysis. The treatment of the solution with organic solvents like ether and chloroform left a water insoluble residue. Attempts were made to elute the toxin from an anion exchange resin with 1N NaOH and ether. After ether elution, the ether was evaporated and the residue redissolved in chloroform. The eluted toxic solution was used to run a test on an infrared spectrophotometer. An analysis of the peaks showed a possibility of NH2 or OH, COOH and alkane groups.

Microfilm \$2.50; Xerox \$4.20. 77 pages.

SEEDLING SELECTION OF HIGH YIELDING ASPARAGUS PLANTS

(L. C. Card No. Mic 60-1451)

Donald Frederick Scheer, Ph.D. Rutgers University, 1960

Major Professor: Dr. J. Howard Ellison

Variation among individual asparagus plants and poor stand early in the life of commercial beds are two important causes of low crop yield. The objective of this study was to devise methods of selecting high yielding asparagus plants in the seedling stage.

Asparagus seedlings were grown in the greenhouse and low, medium, and high vigor individuals were selected on the basis of stalk number x diameter of the largest stalk per plant two and one-half months after sowing. These individuals were then transplanted into the field for observation. Low vigor asparagus seedlings were poor in survival and general field vigor as compared to high vigor seedlings. Correlation studies revealed a positive association between first year yield and seedling stalk number among females. Associations with male plants were not clear.

The character association between female plant yield and seedling stalk number might serve as the basis of a selection technique for seedlings. The elimination of low vigor plants in the seedling stage might improve plant stand as well. More research is needed, however, before definite conclusions can be drawn.

Microfilm \$2.50; Xerox \$3.00. 45 pages.

AGRICULTURE, PLANT PATHOLOGY

SOIL TEMPERATURE AND SOIL MOISTURE FACTORS AFFECTING THE SURVIVAL OF EGGS OF THE ROOT-KNOT NEMATODES MELOIDOGYNE JAVANICA JAVANICA AND M. HAPLA.

(L. C. Card No. Mic 60-1292)

Robert Alexander Campbell Daulton, Ph.D. North Carolina State College, 1960

Supervisor: Charles Joseph Nusbaum

Plant roots infected with the root-knot nematode, Meloidogyne javanica javanica (Treub, 1885) Chitwood, 1949, were obtained from geographically separated areas representing a diversity of soil temperature and soil moisture conditions. These populations were given designations based upon an abbreviation of the place of origin as follows: S.R. - Southern Rhodesia; Ga. - Georgia; N.C. - North Carolina. A single egg-mass was used to establish a stock culture of each of the three M. javanica javanica populations and of Meloidogyne hapla Chitwood, 1949. Egg-masses of all four populations were exposed to various soil temperature and soil moisture stresses under controlled conditions and to natural overwintering in field soil. Viability of eggs after treatment was measured by the bioassay method. At a soil temperature of 28° F. eggs of M. hapla can survive for a longer period than those of M. javanica javanica. Of these populations, S.R. has the least tolerance, N.C. has the greatest, and Ga. is intermediate. At this temperature eggs of all four populations are killed more rapidly in damp soil than in dry soil, whereas, at 97° and 104° F. they are killed more rapidly in dry soil. The response of M. javanica javanica and M. hapla to these high temperatures is the reverse of that found at 28° F., eggs of the latter are less tolerant than those of M. javanica javanica. The N.C. eggs are least able to withstand high temperature, those of S.R. are most tolerant, and Ga. is intermediate. Certain individuals within each of the four populations exhibit increased tolerance to 28° F. and others to 97° F., but tolerance to 28° F. is not associated with response to high temperatures. In soil moisture studies two techniques for maintaining prescribed soil moisture levels (soil columns of varying height in glass cylinders and soil subjected to suction in sintered-glass funnels) give comparable results. Using the S.R. and Ga. populations of M. javanica javanica there is a greater and more rapid reduction in viability of eggs in wet soil (20.4 percent moisture content) than in dry soil (3.4 percent moisture content). The S.R. eggs can withstand exposure to both wet and dry soil more successfully than those of the Ga. population. It is suggested that the more rapid reduction in egg viability in wet soil is due to relatively quick hatching of eggs and increased activity of the larvae in this environment, resulting in depletion of stored energy, exhaustion, and death. Eggs of the two M. javanica javanica populations, S.R. and Ga., cannot survive exposure to atmospheric relative humidities of 0 and 20 percent, and also 90 and 93 percent for 24 hours and 5 days, respectively. Both populations can withstand exposure to 100 percent relative humidity for 20 days. There is a marked reduction in the viability of the Ga. eggs after 5 days, whereas those of S.R. are relatively unaffected

after 20 days exposure. The ability of M. hapla eggs to overwinter is very marked and the differences between the three M. javanica javanica populations are pronounced. Egg viability of S.R. is greatly reduced after 98 days exposure and none survived 139 days or longer. The N.C. eggs show only a moderate reduction after 98 days and some remain viable for 208 days. The Ga. population is intermediate, few eggs remaining viable after 139 days exposure. It is postulated that differences of the degree of tolerance of the M. javanica javanica populations to both soil temperature and soil moisture may to some extent be due to the climatic conditions under which the three populations have evolved.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

NATURALLY OCCURRING QUINONES IN WHEAT AND BARLEY AND THEIR TOXICITY TO LOOSE SMUT FUNGI

(L. C. Card No. Mic 60-1300)

Marshall Ellis Mace, Ph.D. North Carolina State College, 1960

Supervisor: Teddy Theodore Hebert

Previous workers have isolated 2-methoxy-p-benzo-quinone, 2,6-dimethoxy-p-benzoquinone, and 2-methoxy-quinol from wheat germ and tentatively identified them in barley germ. It has been suggested that these compounds may play a role in the control of loose smut of barley, incited by <u>Ustilago nuda</u>, and loose smut of wheat, incited by <u>Ustilago tritici</u>, by the water-soak and anaerobic treatments. Studies were undertaken to determine the toxicity of these compounds and to correlate their appearance in wheat or barley with the control of loose smut obtained by water-soak or anaerobic treatment.

Smutted Knox wheat and Colonial barley were soaked in water containing sulfhydryl-type compounds known to act as inhibitors of the toxic action of 2-methoxy-p-benzoquinone and 2,6-dimethoxy-p-benzoquinone. No significant interference with control of loose smut obtained by water-soak treatment was noted. It was not possible, however, to demonstrate entry of sulfhydryl-type compounds into the grain; therefore, their failure to interfere with loose smut control cannot be interpreted as proof that the naturally occurring quinones in wheat and barley germ do not function in the control of loose smut of wheat and barley by the water-soak method.

Pure 2-methoxy-p-benzoquinone, 2,6-dimethoxy-p-benzoquinone, and 2-methoxyquinol were synthesized and their relative toxicity and mode of toxic action to U. nuda and U. tritici spores and mycelium investigated. All 3 compounds were highly toxic to U. nuda and U. tritici spores, with 2-methoxyquinol and 2-methoxy-p-benzoquinone being considerably more toxic than 2,6-dimethoxy-p-benzoquinone. The most toxic compound to U. nuda and U. tritici mycelium was 2-methoxy-p-benzoquinone, with 2-methoxyquinol and 2,6-dimethoxy-p-benzoquinone being less toxic in that order. The toxic action of these 3 compounds on loose smut spores and mycelium appears to be fungicidal rather than fungistatic. In vitro studies of the influence of sulfhydryl-type compounds on the toxicity of

2-methoxy-p-benzoquinone, 2,6-dimethoxy-p-benzoquinone, and 2-methoxyquinol to <u>U. nuda</u> and <u>U. tritici</u> spores indicated that a portion of their toxic action may be attributed to their ability to combine with or oxidize essential sulf-hydryl groups in loose smut spores.

Spectrophotometric assays of extracts from smutted wheat and barley indicated that 22.2 to 28.1 per cent of the 2-methoxyquinol glucoside present in wheat and barley germ was lost during anaerobic or long water-soak treatment. Colorimetric tests indicated that the reduction in 2-methoxyquinol glucoside during treatment resulted in the appearance of free 2-methoxyquinol in wheat and

barley germ. If 2-methoxyquinol or its oxidation product, 2-methoxy-p-benzoquinone, accumulates in the germ in amounts equivalent to the decrease in 2-methoxyquinol glucoside concentration during treatment, the concentration would be far in excess of that required to kill the mycelium of <u>U. nuda</u> or <u>U. tritici in vitro</u>. However, extracts of wheat and barley treated by anaerobic and long water-soak methods did not contain detectable amounts of 2-methoxyquinol, 2-methoxy-p-benzoquinone, or 2,6-dimethoxy-p-benzoquinone when examined by paper chromatography.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

ANATOMY

STUDIES ON THE HYPOTHALAMO-HYPOPHYSEAL NEUROSECRETORY SYSTEM IN THE NORMAL AND HYPOPHYSECTOMIZED RAT

(Publication No. 22,586)

Dorothy Corinne Billenstien, Ph.D. University of Colorado, 1956

Supervisors: Associate Professors Ernst Scharrer and Theodore S. Eliot

For many years it had been suspected that the posterior lobe hormones of the hypophysis were synthesized in the supraoptic and paraventricular nuclei of the hypothalamus. Not until recently, however, have histological techniques have developed which stain the neurosecretory material throughout the hypothalamo-neurohypophyseal system. These techniques have been instrumental in establishing the hypothalamus as the site of origin of the posterior lobe hormones of the pituitary gland. Antidiuretic drugs such as nicotine, morphine, and cinchoninic acid derivatives are thought to act by way of the hypothalamo-neurohypophyseal system. Bodian has shown that 3-hydroxy-2phenylcinchoninic acid causes a histologically demonstrable depletion of stainable neurosecretory material from the nerve terminals of the neurohypophysis in the opossum. In one of the investigations reported in this thesis the effects of 3-hydroxy-2phenylcinchoninic acid were studied in the neurohypophysis of the normal rat. A reduction of stainable neurosecretory content was observed. Similar studied were carried out with nicotine, but the results were inconclusive.

One aspect of the hypothalamo-hypophyseal system that has caused considerable controversy is the fate of the posterior lobe hormones following hypophysectomy. Recently, antidiuretic hormone has been found in the serum of hypophysectomized animals. The source of this antidiuretic substance is suspected to be the hypothalamus, but it has not been shown conclusively. Stutinsky described regenerated neurohypophyseal tissue capable of storing neurosecretory material. Stutinsky's work has been confirmed, but the problem remained to demonstrate morphologically that the reorganized tissue was functionally competent. Attempts to deplete the reorganized neurohypo-

physeal tissue of stainable neurosecretory substance in the hypophysectomized rat by methods of dehydration that cause depletion in the normal animal have been unsuccessful. It has been observed by other investigators that adrenal cortical substances caused an acceleration of water exchange in the hypophysectomized animal. Experiments reported in this thesis are based upon the reasoning that by increasing the rate of water exchange in the hypophysectomized animal a greater demand for the neurohypophyseal antidiuretic hormone would occur. This might be expected to manifest itself by a microscopically visible depletion of stainable neurosecretory material in the reorganized neural lobe tissue of the hypophysectomized animal. This could be interpreted as morphological evidence of the functional competence of the reorganized structure.

In this investigation desoxycorticosterone acetate was administered to hypophysectomized rats together with dehydration procedures. With this method it was possible to demonstrate an almost total depletion of neurosecretory granules from the reorganized neurohypophyseal tissue. Thus, it has been demonstrated on a morphological basis that posterior lobe hormones can be released in the hypophysectomized rat in response to a suitable stimulus. From the above study it could not be determined whether adrenal cortical substitution therapy alone would cause depletion of neurosecretory material or whether dehydration was also necessary. Therefore, an experiment was designed for the purpose of answering this question. The findings indicate that both cortisone and sodium chloride are necessary to cause depletion of stainable neurosecretory material from the reorganized neurohypophyseal tissue in the hypophysectomized rat in sufficient amounts to be detected by the histological methods used in these investigations. Sodium chloride and sodium chloride with cortisone administration were the two experimental conditions that apparently caused increased activity of the cells of the supraoptic nucleus. Cytological changes were also observed in the zona glomerulosa of the adrenal

Microfilm \$2.50; Xerox \$6.80. 145 pages. Mic No. 60-1731

DURATION OF FUNCTIONAL SYMPATHETIC DEFICIT FOLLOWING DISRUPTION OF CRANIAL POSTGANGLIONIC FIBERS

(L. C. Card No. Mic 60-1240)

Jennifer Sullivan Buchwald, Ph.D. Tulane University, 1959

Chairman: Dr. Homer D. Kirgis

Further study of postganglionic sympathetic regeneration is indicated both by the paucity and contradictory nature of the experimental work which has been done and the increasing clinical interest in postganglionic surgery for therapeutic purposes. The purpose of the present investigation is to provide additional information in this area. In the work reported the duration of functional deficit in the cat is determined following section of the superior cervical postganglionic fibers, following resection of the same fibers and following compression of the internal carotid nerve in the middle ear. Standardized criteria of functional recovery of the denervated effectors (smooth muscle of the eye and ear vessels) are utilized and postganglionic regeneration is confirmed by positive responses of the recovered effectors to preganglionic stimulation.

The results indicate that superior cervical postganglionic fibers regenerate rapidly to their peripheral endings, i.e., the smooth muscle of the eye and ear vessels. Regardless of the type of operation performed on the postganglionic fibers (compression, section, resection), the time required for functional recovery of the peripheral effectors was between one and two months. Following section of the internal carotid nerves, the mean time for functional recovery of the dilator pupillae, retractor of the nictitating membrane and superior tarsal muscle was 67 days; vasomotor tone in the ear vessels returned at a mean of 32 days. After the production of a gap (3 to 4 mm) in the internal carotid nerve, functional recovery of the smooth muscles of the eye occurred at a mean of 63 days; return of ear vessel vasomotor tone occurred at a mean of 30 days. Following compression of the internal carotid nerve in the middle ear, recovery from Horner's syndrome occurred at a mean of 37 days; recovery of vasomotor tone occurred at a mean of 20 days. Functional recovery of the dilator pupillae and nictitating membrane was found to coincide with their reinnervation as indicated by electrical stimulation. In all types of postganglionic operations performed, the course of recovery of the peripheral effectors was the same. The dilator pupillae, retractor of the nictitating membrane and superior tarsal muscle showed functional recovery at the same time, while recovery of vasomotor tone of the ear occurred in approximately half this time. Hyperactivity of the dilator pupillae and smooth muscle of the ear vessels was noted one to two weeks after functional recovery of these structures occurred. A functionally important component of the internal carotid nerve in the middle ear is shown to exist, the terminations of which are in the dilator pupillae, retractor of the nictitating membrane, superior tarsal muscle and inconstantly in the smooth muscle of the ear vessels.

Microfilm \$2.50; Xerox \$4.60. 89 pages.

ANTHROPOLOGY

ARCHEOLOGICAL EXCAVATIONS AT JAMESTOWN, VIRGINIA.

(L. C. Card No. Mic 59-4608)

John Lambert Cotter, Ph.D. University of Pennsylvania, 1959

Supervisor: Alfred Kidder II

Problem. Following the abandonment of the first settlement as capitol of the Colony of Virginia in 1698, the physical remains of the townsite on Jamestown Island deteriorated until less than a score of houses remained in ruins at the time of the American Revolution. By mid-19th century, only the brick church tower remained above ground. From 1901 to 1958 some 20 acres of the area of Jamestown were explored archeologically, mainly under the auspices of the National Park Service. The objective of these explorations and related historical research was a more factual and concrete knowledge of the actual location and character of the settlement. In particular, the hypothetical location of the first fort of 1607 variously proposed by certain historians and architects was to be resolved by concrete evidence, the extent of cemeteries defined, and additional structural remains uncovered, described,

identified where possible, and related to the appropriate temporal position in a functional community. Knowledge of the type of housing employed after the first, faltering efforts at construction, together with an exact interpretation of the utensils, artifacts and manufactures associated with daily life here in the 17th century and early 18th century would permit a more accurate interpretation of the passage of a purely English 17th century community through the physical and cultural frontier of a new land. Thus, indications of adaptation of custom, skills, artifacts and products of innovation and by acculturation through contact with the American aborigines was to be sought out.

Procedure and Methods. Various techniques of archeological testing and development of features were used over a 50-year period; however, the major and culminating excavations of 1953-57, conducted by the writer, entailed a 50-foot interval grid network of test trenches 3 feet wide to undisturbed earth, representing a total length of 6 miles and covering 8 acres of ground. Features such as structures, wells, pits and ditches so encountered were developed selectively so as to reveal their proportions and allow general observations, photographs, field drawings, and final measured renderings for Historic American Building Survey archives at The Library of Congress. Artifacts recovered were processed in the laboratory

maintained on the island for the purpose, cleaned, preserved, recorded and studied. Data so gathered were recorded in permanent records and museum accession lists, and after final analysis were described in the present report.

Results. Major achievements of this work were:

- 1. Establishment of the location of the first fort site, now destroyed by river erosion, off Church Point, on Jamestown Island.
- 2. Discovery of a second and probably the earlier, cemetery at the settlement, inferentially dating from the Starving Time of 1609-10.
- 3. Discovery of the earliest glass factory, brick kiln, ice storage device, pottery kilns, forge and iron smelting pits in English America.

4. Uncovering of 142 structures of all types, including brick and frame house foundations, a bridge of brick rubble, over 30 wells, plus 94 property line ditches.

Conclusions: As the frontier changes all who pass it, the first permanent English settlers on American soil failed to establish a typical English village and community. Instead, evidence shows that from the earliest years, the forces of acculturation imposed upon, or sought by, the settlers from the environment and the aborigines set in motion forces which gave birth to a new variant of Western Civilization, and a new nation.

Microfilm \$4.35; Xerox \$15.30. 339 pages.

ARCHAEOLOGY

THE PHILIPPINE IRON AGE

(L. C. Card No. Mic 59-6599)

Wilhelm Gerhard Solheim, II., Ph.D. University of Arizona, 1960

Supervisor: Dr. Emil W. Haury

This study examines in the light of new data, H. Otley Beyer's hypothesis of the source of the Philippine Iron Age. Beyer's hypothesis is that Iron Age culture was brought into the Philippines from the south by the Malay.

The new data presented came from a site dug in Masbate by Wilhelm G. Solheim II in 1951 and 1953 and from a large archaeological collection at the University of Michigan Museum of Anthropology. This collection was made by Dr. Carl Guthe from 1922 to 1925 on many of the islands making up the Visayan Islands in the central Philippines, plus a few sites from Mindanao, Palawan, and the Calamianes. The majority of these data have to do with pottery.

The pottery is classified into the Kalanay, Bau, and Novaliches pottery complexes. The Kalanay pottery is distinguished by several incised designs and great variety in form. It is found at sites scattered throughout the Visayan Islands and northwest Palawan. The Bau pottery is distinguished by a few simple impressed designs. It is found at sites in Mindanao, a few islands in the southeastern part of the Visayas, and northwest Palawan. The Novaliches pottery is distinguished by incised, impressed, or carved decorations on the high ring feet of shallow bowls.

This pottery is found at sites in northwest Palawan and on Luzon in the Neighborhood of Manila.

In northwest Palawan the three complexes may have entered at approximately the same time. In the Visayas in Kalanay pottery was present first and probably entered at about the same time as did the Novaliches pottery around Manila. The Bau pottery came into Mindanao later.

The Kalanay pottery is most closely related to pottery from Sa Huynh, Annam. The Bau pottery is closely related to that pottery made today by various Malay groups, and was present archaeologically in south China around 500 B.C. The source of the Novaliches pottery is not yet known.

Beyer's hypothesis of the Philippine Iron Age was based on the archaeological sites near Manila, in which Novaliches pottery was found. The people making the Novaliches pottery, though of unknown origin, were not Malays, though they may have come from the south. The makers of the Kalanay pottery brought the Iron Age to the Visayan Islands, probably from Indochina. The makers of the Bau pottery, which of the three can be most closely connected with the Malay, brought the Iron Age into Mindanao, but at a later date than its arrival to the north. They came into Mindanao from the south, probably the Celebes, but earlier may have come to Palawan directly from south China. The Bau pottery is being made today in northern Luzon and may have arrived there at an early date along with the use of iron, from Palawan or south China.

Microfilm \$7.05; Xerox \$25.00. 554 pages.

BACTERIOLOGY

EFFECTS OF VEGETABLE TANNINS ON DECOMPOSITION OF SOME ORGANIC COMPOUNDS

(L. C. Card No. Mic 60-1421)

Joseph Basaraba, Ph.D. Rutgers University, 1960

Major Professor: Robert L. Starkey

The effects of two commercial vegetable tannins, chestnut-wood extract and wattle (mimosa) extract on decomposition of gelatin, gliadin, peptone, phenylalanine, lysine, guanidine, and cellulose were investigated. Also, a preliminary study was made of the effect of a purified preparation of wattle tannin on decomposition of gelatin.

Decomposability under attack by a mixed soil population was tested on aerated solutions of the tannins in a mineral salts medium. The nitrogen compounds were used at a concentration of 0.500 per cent and the tannins were used alone and with the nitrogen compounds at concentrations of 0.125, 0.500 and 2.000 per cent (w/v). One series of media was maintained at pH 4.0 and another at pH 7.0. The amounts of carbon dioxide released and ammonia released or assimilated in 21 days served as criteria of decomposition.

Precipitates (complexes) were formed rapidly when the tannin solutions were mixed with the solutions of the nitrogenous substances. The tannin-protein complexes were brown gummy floccules which settled, coalesced and adhered to the walls of the flasks. The tannin-protein complexes prepared and incubated at pH 4.0 were physically stable and biologically resistant to decomposition. Similar complexes in neutral solutions tended to dissociate, and consequently decomposed to a greater extent. The complexes formed from proteins and chestnut-wood or wattle tannin appeared similar but those formed from chestnut-wood tannin and protein showed a somewhat greater tendency to dissociate in the neutral liquid media. Purified wattle tannin reacted with gelatin more rapidly than did the crude wattle tannin extract but the appearance of the precipitated product was similar. On mixing the tannins with peptone, a fine brown and mostly dispersed precipitate was produced, but most of the insoluble material had disappeared by the time the experiments were terminated after 21 days. Small amounts of fine brown precipitates were formed from mixtures of the tannins and amino acids and guanidine. These complexes were relatively susceptible to microbial attack. Wattle tannin slowly reacted with cellulose to produce brown cellulosic material.

The commercial chestnut-wood and wattle extracts contained 72.7 and 64.5 per cent tannins and 26.5 and 31.8 per cent non-tannins respectively (dry weight basis). Most of the non-tannin material in the chestnut-wood extract was gums, whereas that in wattle extract was free sugars. The purified preparation of wattle extract was nearly free from both gums and sugars.

The crude chestnut-wood and wattle tannins decomposed fairly rapidly and more so at pH 7.0 than at pH 4.0. Purified wattle tannin decomposed very slowly; approximately one-fourth as much carbon dioxide was produced from the purified preparation as from the crude extract.

The proteins, peptone, and amino acids decomposed rapidly whereas the guanidine and cellulose decomposed slowly. Mixtures of proteins and tannins were very resistant to decomposition, especially in the acid media. The effects of both tannins on decomposition of gelatin or gliadin were similar.

The inhibitive effect of purified wattle tannin on degradation of gelatin was approximately 2 to 4 times greater than that of the crude wattle tannin. The tannins had little inhibitive effect on decomposition of peptone, phenylalanine, or lysine. There was somewhat greater inhibition at pH 4.0 than at pH 7.0 but differences were slight. Mixtures of chestnut-wood tannin and guanidine decomposed practically at the same rates as did the tannin alone. Wattle tannin inhibited decomposition of cellulose only slightly.

In all instances, when a crude or purified tanning material was tested alone or in mixtures with the organic nitrogen compounds in acid or neutral media fungi, predominantly Aspergillus niger and Penicillium sp., grew actively. Bacteria developed in neutral solutions which contained either the nitrogenous compounds or mixtures of these compounds with tannins.

Microfilm \$2.50; Xerox \$6.40. 133 pages.

INTERACTION OF NEWCASTLE DISEASE VIRUS WITH HOST CELLS OF VARIOUS TISSUE CULTURE LINES

(L. C. Card No. 60-1266)

Donald Paul Durand, Ph.D. Kansas State University, 1960

Recent developments in tissue culture techniques have opened new horizons to the animal virologist. These methods allow studies comparable to the fruitful investigations carried out in recent years on the bacteriabacteriophage relationship. Utilizing tissue culture techniques, this thesis was concerned with three problems associated with interactions between animal cells and viruses: (1) whether host cells could modify genetic properties of animal viruses, (2) whether a vaccine strain of Newcastle Disease Virus could interfere with multiplication of more virulent strains of the virus, and (3) whether the rate of ultra-violet inactivation of virus would be influenced by the state of its relationship with the host cell.

Standard tissue culture procedures were modified to suit the particular needs arising during experimentation.

The cell types employed were human intestine, HeLa, sarcoma 180, liver (Chang), KB (Eagle), Detroit 98, bovine kidney, bovine skin and muscle, and chicken embryo fibroblasts. The Newcastle disease virus (NDV) strains used included Iowa 174, Iowa 23, Luginbuhl Conn. 70726, Cal. Ro., Cal. 11914, Mass. MK, and B₁.

Attempts were made to determine the stability of host range and infectivity of several strains of NDV during multiplication in bovine, human and chicken cell lines. It was found that during a single passage in different cell lines, the host range and infectivity were stable and refrac-

tive to any detectable control by the host.

Interference between viable strains of NDV was studied both qualitatively and quantitatively. The B₁ strain of NDV used did not form plaques or cause gross cell destruction. However, all other strains of NDV tested did cause rapid production of plaques on chicken embryo fibroblasts (CEF). It was demonstrated in studies of the interaction between viable viruses that NDV-B₁ was capable of blocking successful infection, as judged by subsequent plaque formation, by strains NDV-Cal. 11914 and NDV-Cal. Ro. The evidence indicates that a single particle of the interfering virus (NDV-B₁) can exclude the superinfecting virus. Data show that NDV-B₁ blocks superinfection more completely when it is present in higher multiplicities and when it is allowed time for adsorption prior to addition of the superinfecting strain.

Experiments were performed to determine the effects of UV radiation on (1) viability of virulent and nonvirulent strains of NDV in the free state, (2) ability of host cells (CEF) to support virus multiplication, and (3) viability of virus at different stages after adsorption to host cells. All strains of NDV in the free state were inactivated by UV radiation at the same rate. The B₁ strain, which has many characteristics in common with temperate phages, might have been expected to show the relatively high UV resistance of such phages. However, it was inactivated at a slightly higher rate than the other strains tested, thus making the existence of a lysogenic state between B₁ and its host cell unlikely if this rationale is a valid one.

The capacity of CEF to support NDV replication was highly resistant to inactivation by UV radiation. CEF even appeared to be rendered more susceptible to infection when treated with low doses of UV radiation.

When the virus was allowed to adsorb to host cells for sufficient time prior to irradiation, its resistance to destruction by UV was markedly increased. When adsorption proceeded for $4\frac{1}{2}$ hours before UV treatment, no inactivation of the virus was detected at the radiation dosage used.

Microfilm \$2.50; Xerox \$4.80. 95 pages.

THE ROLE OF LACTIC ACID BACTERIA IN FERMENTED SAUSAGES

(L. C. Card No. Mic 60-1487)

Raymond Curry Erickson, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor E. M. Foster

Several cured comminuted meat products are deliberately caused to undergo a lactic acid fermentation during

their manufacture. Until recently no cultures were available commercially for inoculating sausages, and even now many, if not most, meat packers rely on chance contamination to provide the necessary bacteria. The purpose of this work was to study the bacterial flora of salami, a type of "summer sausage," and to ascertain the function, if any, of the lactic acid bacteria that grew therein.

Initially the predominant organisms were isolated from three commercial brands of salami. The majority of isolates comprised a morphologically and physiologically homogenous group of homofermentative lactobacilli that could be divided into two groups—those that produced copious amounts of thick, gummy polysaccharide when grown on sucrose, and those that did not.

To learn the fermentation products of these organisms and thereby gain insight into their possible contribution to sausage manufacture, four representatives of each type were grown in sucrose broth under nitrogen at 25 C. Carbon recoveries for all cultures ranged from 93.3 to 103.4 per cent of the sucrose utilized, with lactate accounting for 92.6 to 94.4 per cent of the recovered carbon. Other carbon compounds found were glycerol, carbon dioxide, acetate, formate, ethanol, 2,3-butanediol, acetone, acetoin and diacetyl.

The fermentation patterns of all cultures were similar. Moreover, all converted about two-thirds of the sucrose to fermentation products (other than polysaccharide). The gum forming organisms changed the other one-third of the sugar to polysaccharide, whereas the non-polysaccharide formers left about one-third of the sucrose unused.

The polysaccharides formed by three cultures were purified and subsequently identified as dextrans.

The temperature of incubation had a pronounced effect on sucrose utilization by the dextran formers. As the temperature was reduced from 37 to 15 C, more sucrose was utilized and more dextran was produced. Between 15 and 30 C there was little difference in the total amount of lactate produced by a culture. These findings, coupled with results of studies of sucrose hydrolysis by cell-free preparations, suggested the activity of at least two enzyme systems. At lower temperatures it appeared that sucrose was cleaved primarily via the enzyme dextransucrase, whereas at higher temperatures it was hydrolyzed by the enzyme sucrase.

The fermentations in two commercial lots of salami were followed throughout production. Both developed a homofermentative lactic acid flora and the finished products contained, on a wet weight (w/w) basis, 1.5 per cent lactic acid, 0.07 per cent acetic acid, and 0.03 to 0.04 per cent formic acid. An insignificant amount of residual sucrose and no diacetyl or acetoin was detected.

One lot contained 0.36 per cent (w/w) polysaccharide; the other 0.15 per cent. The former behaved "normally" during manufacture and contained over one billion lactic acid bacteria per gram (95 per cent polysaccharide formers) at the height of the fermentation. Changes in the other lot were slower than normal. This might have been associated with both its lower content of lactic acid bacteria and the fact that only half of them were polysaccharide formers.

The organisms predominant during the active fermentation in the commercial sausages were similar to those isolated earlier from the finished products. Therefore, it seems reasonable to assume that the detailed fermentation studies conducted with pure cultures obtained from

finished products can be used to interpret changes in the sausage during active fermentation.

From the results of this study it would appear that active growth of homofermentative, dextran producing lactobacilli is associated with rapid changes during manufacture and desirable characteristics in the finished product.

Microfilm \$2.50; Xerox \$7.40. 156 pages.

STUDIES UPON THE DISTRIBUTION AND IDENTIFICATION OF STREPTOCOCCUS FAECALIS AND STREPTOCOCCUS FAECIUM

(L. C. Card No. Mic 60-1308)

Frank M. Ferraro, Ph.D. University of Southern California, 1960

Chairman: Professor Appleman

The determination of the presence or absence of fecal contamination has been based upon the use of indicators of pollution which have included the coliform and enterococcus groups.

This dissertation reports a study to determine in a semiquantitative manner the presence of enterococci and to characterize the types in (1) the intestinal contents of man and selected animals, (2) field, garden, and orchard soils, including recently manured soils, (3) the exterior and interior structure of fruits grown on these soils, and (4) raw cow's milk.

In man and animals the enterococci found ranged between 10⁴ and 10⁸ per gram of fecal material except in rabbits. Of 30 rabbits examined 27 failed to show the presence of these organisms. The explanation for this is not apparent, since it was known that the rabbit feed did not contain any added antimicrobial substances.

The number of enterococci present per gram of fecal material could fluctuate intermittently as much as a hundredfold in the fécal material of rats and mice, but the numbers were always high.

Fertilized and nonfertilized soils, and plants grown thereon, showed the presence of the enterococci. These organisms were recovered regardless of the type of fertilizer used. In both fertilized and nonfertilized soils the organisms were found up to 1,000 per gram. This concentration was quite consistent for field, garden, and orchard soils.

The enterococci were found on the husks and kernels of corn and the pods of beans. They were found also on the exterior surface of apples grown in nonsprayed, nonfertilized orchards, but not on the exterior surface of sprayed apples. The interior of sprayed and nonsprayed apples and also the ovules of beans were free of the organisms.

Enterococci were never recovered from raw cow's milk in samples smaller than 0.01 ml. Usually only the analysis of the undiluted milk samples resulted in demonstration of the organisms.

Approximately two thousand isolates were obtained from human, animal, soil, and plant sources. Based on their physiological characteristics as described in the literature, the isolates were classified into two groups, Streptococcus faecalis and Streptococcus faecium. The majority conformed to the characteristics of the latter group.

It was noted in this study that a large number of isolates could not be placed in either of the above groups because of their divergency in fermentation of certain sugars. These enterococcus-like organisms fulfilled all the requisites for enterococci and were designated as S. faecalis-like, S. faecalis var. liquefaciens-like, and S. faecium-like. The S. faecium-like organisms occurred most frequently.

In the seventh edition of Bergey's Manual, S. lique-faciens and S. zymogenes are considered as varieties of S. faecalis, S. faecium is not recognized, whereas S. durans is given species status among the enterococci. Since organisms corresponding to Orla-Jensen's description, S. faecium, were recovered more frequently than any other member of the enterococcus group from the sources examined, it is logical to conclude that these organisms should be designated as a distinct species and recognized in the next edition of Bergey's Manual.

Microfilm \$2.50; Xerox \$6.00. 122 pages.

TRANSMISSION OF FOOD-POISONING ORGANISMS BY THE BROWN-BANDED ROACH (Supella supellectilium), SERVILLE, 1839.

(L. C. Card No. Mic 60-1269)

John Luther Joy, Ph.D. Kansas State University, 1960

This study is concerned with the capability of the brown-banded roach (Supella supellectilium, Serville, 1839) to transmit certain food-poisoning microorganisms.

The first study consisted of feeding experiments to determine the ability of the brown-banded roach to transmit food-poisoning organisms through its fecal pellets. The following test organisms were used: Salmonella typhosa, Salmonella choleraesuis, Salmonella schottmuelleri, Salmonella paratyphi, Salmonella derby, Shigella paradysenteriae, Shigella sonnei and Staphylococcus aureus

The cockroaches were fed test organisms and the feces checked. After the feeding period, the cockroaches were either macerated or dissected and the crop, caeca, ventriculus and intestine, and the rectal sac were cultured for the test bacterium. Of eighty cockroaches fed salmonellae, only three passed the organisms in their feces. All fecal recoveries were of S. typhosa. Other species of Salmonella persisted in the cockroaches as follows: S. derby for 144 hours, S. schottmuelleri for 48 hours and S. choleraesuis for 12 hours. S. paratyphi was not recovered. Of fourteen S. aureus feedings, only one negative culture was found. S. aureus was excreted in the feces for 96 hours and was harbored in the body of the cockroach for 168 hours. A quantitative study revealed that S. aureus decreased as it passed along the cockroach's digestive tract.

In a second study, an effort was made to detect substances in or on the cockroach which might inhibit bacteria. Spot plates were made of the whole cockroach, macerated alimentary tracts of cockroaches, and parts of the alimentary tract. No inhibition of the test organisms was indicated.

A third study concerned the transmission of the test organisms on the cockroach's "feet." The cockroaches were exposed to plates of the test organisms and transferred to sterile Petri dishes for specified time intervals. After each interval, the cockroaches were checked for persistence of the test organisms. All of the test organisms except S. choleraesuis were carried on the "feet" of the cockroaches.

In a fourth study on food preferences of cockroaches they were allowed to select food from the following: bacon, salad dressing, potato, banana, human feces, bread with sugar water, cream filling, cottage cheese and beef. The order of preference was bread with sugar water, cream filling, banana, and beef. It was significant that the cockroaches did not feed on human feces; however, they walked over the feces.

A survey of the "normal" bacteria of the brown-banded roach resulted in the recovery of naturally present Staphylococcus aureus; no Salmonella or Shigella species were recovered.

The five experiments revealed that all of the test organisms were carried in some manner. The shortest period of transmission was 12 hours for S. choleraesuis, and the longest period was 192 hours for S. typhosa.

Evidence indicated that S. typhosa, S. choleraesuis, S. schottmuelleri and S. sonnei were more likely to be harbored in the body of this cockroach than to be transmitted through its feces or on its "feet." S. paradysenteriae and S. paratyphi are more likely to be transmitted on the "feet" of the cockroaches. The cockroach's feces were the least likely means of transmitting Salmonella and Shigella species; the crushed body of the brown-banded roach represents a greater public health menace than the fecal pellets. Although this cockroach did not eat human feces, it would be possible for its "feet" to be contaminated by pathogens in human feces.

Supella supellectilium is capable of transmitting S. aureus by its feces, its crushed body, and on its "feet." In addition, natural infections with S. aureus were observed.

Although the number of S. aureus cells released by contaminated brown-banded roaches decreases with time, transmission of S. aureus represents the greatest potential health hazard from the brown-banded roach as a transmitter of food-poisoning organisms.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

THE THERMAL DEATH TIME CURVE OF MYCOBACTERIUM TUBERCULOSIS VAR. BOVIS IN ARTIFICIALLY INFECTED MILK.

(L. C. Card No. Mic 60-1436)

Herbert Ross Kells, Jr., Ph.D. Rutgers University, 1960

Major Professor: S. A. Lear

The nature of the thermal death time curve of Mycobacterium tuberculosis var. bovis in milk was investigated in this study. Milk which was artificially infected with a known concentration of viable tubercle bacilli was heat treated in the laboratory employing equipment which provided instantaneous heating, efficient mixing, extremely

rapid cooling, and accurate sampling at very short time intervals.

In the course of the thermal death time experiments, the test suspensions were injected into a temperature controlled heating bath under positive pressure at "zero" time. At preset time intervals samples were withdrawn from the heating bath automatically under vacuum. Electrical impulses from a timing device activated solenoid valves and caused the samples to be withdrawn into sterile vials set in an ice water bath. Recovery of the surviving organisms was accomplished in synthetic media. Three strains of M. tuberculosis var. bovis were employed in this study. (USDA #854, ATCC #11756, and ATCC #12621) A thermal death time curve for each strain was determined in the temperature range of 60°-69°C., and the effect of cell clumping upon the "z" value of this organism in milk was determined.

The differences in "z" values of the thermal death time curves for the three strains was found to be quite small with the experimental range being 4.8°C. (8.6°F.) to 5.2°C. (9.4°F).

The thermal death time curves of all three strains were found to be linear in the range of 60°-69°C.

The extent of cell clumping in the test suspensions had no effect upon the "z" values obtained in this study for strain 11756.

All the thermal death time curves determined in this study at viable cell concentrations in the range of the maximum probable concentration to be found in naturally contaminated milk lie considerably below the curve drawn through the United States Public Health Service pasteurization standards for milk. These results indicate that the present pasteurization standards provide a margin of safety of approximately twenty-eight and a half minutes at 143°F., and approximately fourteen seconds at 161°F.

Microfilm \$2.50; Xerox \$3.00. 55 pages.

ISOLATION AND GROWTH OF NITROSOMONAS EUROPAEA IN PURE CULTURE

(L. C. Card No. Mic 60-1440)

Ronald Freeburg Lewis, Ph.D. Rutgers University, 1960

Major Professor: Dr. D. Pramer

Primary consideration was given to the isolation of N. europaea in pure culture. For this purpose the development of a nitrifying enrichment culture in solution media prepared to be relatively free of particulate material was investigated. Rapid and dispersed growth was obtained in a medium buffered with phosphate. By repeated additions of (NH₄)₂SO₄ and readjustment of the pH at weekly intervals it was possible to obtain a ratio of the number of cells of N. europaea to those of the heterotrophic bacteria that permitted the isolation of the nitrifying organism in pure culture by dilution techniques.

The influence of various factors on the development of N. europaea in solution medium was investigated. Aeration favored growth and the optimum temperature was in the range of 28 to 37°C. Studies of the effects of buffer concentration and nutrient levels resulted in the formulation

of a medium that supported rapid and extensive development of N. europaea. The medium had the following per cent composition: (NH₄)₂SO₄, 0.25; Na₂HPO₄, 1.35; KH₂PO₄, 0.072; NaHCO₃, 0.05; MgSO₄.7H₂O, 0.01; CaCl₂.2H₂O, 0.0018; FeCl₃.6H₂O, 0.0014; final pH 7.8.

The extent to which N. europaea developed in this medium was influenced by end product accumulation. Nitrite was more toxic than nitrate. Greater concentrations of nitrite were required to inhibit cultures in the log phase of development than were necessary to prevent growth initiation and the toxicity of nitrite was greater at acid that at alkaline reactions.

Growth of N. europaea was influenced by chelating agents. In general, an excess (2:1 ratio of chelate to iron) of chelate was toxic. CHEL 600 was an exception and had no adverse effect at concentrations that rendered the medium completely free of particulate material. The toxicity of CHEL 138 and CHEL 330 was reversed by increasing the concentration of metals in the medium.

The amino acids glycine, phenylalanine, and histidine were toxic to N. europaea and the effect varied directly with the concentration of amino acid tested. Glycine was least toxic and histidine the most toxic. The inhibition of N. europaea by histidine was not associated with the ability of the amino acid to complex metals, since it was not decreased by an increase in the concentration of metals in the medium.

The rate and extent to which N. europaea developed under conditions which minimized the adverse effects of pH and substrate depletion were determined in a study of 23 days duration. The concentration of nitrite-nitrogen produced by the organism was 2,240 mg per liter and the most probable number of cells of N. europaea was 5.43 x 10^9 per ml of medium. The culture had a generation time of 35 hours and the amount of nitrite-nitrogen produced per generation was 139.5 μ g per ml. The yield of cell material was 96.6 mg per liter of medium and the free-energy efficiency of the culture was 4.56 per cent.

Cell walls of N. europaea were prepared, hydrolyzed, and the hydrolysate was analyzed chromatographically. The cell wall of N. europaea appeared to be similar in composition to that of other Gram-negative bacteria in that it contained a full array of amino acids, including methionine, cysteine, cysteic acid, and tyrosine.

Microfilm \$2.50; Xerox \$6.20. 130 pages.

THE EFFECTS OF DRYING ON SURVIVAL OF STREPTOCOCCUS LACTIS

(L. C. Card No. Mic 60-1498)

John Kitchel McAnelly, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor E. M. Foster

A quantitative study was made of the ability of five strains of Streptococcus lactis to withstand drying.

Two drying procedures were used: (1) air drying (intended to simulate spray drying) in which a cell suspension was deposited on a standard area of nylon cloth held in an air stream of controlled temperature, flow rate, and relative humidity; (2) lyophilization, in which the cell sus-

pension was placed in a pyrex vial, frozen at -35 C, and held at this temperature under vacuum (35 μ of mercury) for four hours. At the end of this time the freezing bath was removed, the vials were held under vacuum at room temperature for an additional hour, and then were sealed off under vacuum. The dried cells were rehydrated by adding either the cloth or opened vial to a solution of 0.1 per cent peptone. The pour plate method was used to determine the number of living cells before and after drying.

Initial studies showed a large variation between replicate trials in which a culture was lyophilized. This variation was caused by rupture of the bacterial chains during freezing or drying, but much of it could be eliminated by agitating the cultures for 5 minutes in a Waring Blendor before drying.

The five strains showed marked differences in their response to air drying. On the basis of the results, the cultures were separated into two groups, which were designated "high survivors" and "low survivors." The differences observed with air drying were much less apparent when the cultures were lyophilized. All of the strains survived lyophilization better than air drying.

The drying mestruum had little influence on the viability of the two "high surviving" strains. These cultures survived either method of drying as well in M/15 phosphate buffer as in a diluent composed of 2 per cent dextrin, 0.5 per cent each of thiourea and ascorbic acid, and 0.1 per cent peptone. Omitting any of these components did not greatly influence survival of the organisms.

The "low survivors," in contrast, needed the protection afforded by the more complex diluent. For example, one of the strains showed 50 per cent survival in the complex diluent and only 11 per cent in the phosphate buffer.

Although not all of the strains behaved in precisely the same fashion in all of the diluents, the differences between the "high survivors" and "low survivors" appeared to be an intrinsic characteristic of the cells and not an artifact caused by use of any particular drying menstruum. One strain from each of the groups was used in an attempt to determine the nature of this factor(s).

The two strains retained their "high" or "low survivor" characteristic when they were air dried in varying concentrations of phosphate buffer, sucrose, and glucose. Varying the cell concentration from 10⁴ to 10⁹ cells per ml in M/15 phosphate buffer did not alter the air drying survival of either strain.

Microscopic examination of the two cultures showed the presence of a large capsule tightly bound to the cells of the "high survivor." The "low survivor" did not appear to possess much capsular material. Chemical analyses of the two strains showed that cells of the "high survivor" possessed approximately twice as much carbohydrate as the "low survivor" cells. The presence or absence of the capsule appeared to be responsible for the manner in which the strains responded to a drying treatment.

Further evidence for the protective function of the capsule was obtained by incubating the two strains with varying concentrations of lysozyme. Approximately 5 to 7 times as much lysozyme was required to obtain the same response with the intact cells of the "high survivor" as was obtained with the "low survivor" strain. However, the response of the disintegrated cell walls of the two strains to the same level of enzyme was nearly identical. Apparently, the capsule around the cells of the "high

survivor" was blocking the enzyme from reaching the site of action on the cell wall.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

STUDIES ON THE ACTION AND MODIFICATION OF BACTERICIDAL SERUM SYSTEMS

(L. C. Card No. Mic 60-1443)

Jacob Gabriel Michael, Ph.D. Rutgers University, 1960

Major Professor: Dr. Werner Braun

Strains with relatively stable inherent differences to the bactericidal effects of "normal" human serum in vitro were isolated from a widely used stock-culture of Shigella dysenteriae, Type A. This culture had been believed to be relatively homogeneous. The recognition of cultural heterogeneity in regard to serum resistance was made possible by the detection of associated differences in colonial morphology, which became readily apparent with the aid of oblique lighting and the use of appropriate solid media. Most of the substrains thus isolated displayed stable genetic differences to the bactericidal effects of normal human serum, and similar differences to the effects of sera from other species. No qualitative antigenic differences and no differences in fermentative characteristics could be detected among these strains. Strains of Escherichia coli with stable differences in serum susceptibility also were obtained.

An inverse correlation between serum resistance and penicillin resistance was discovered with the aid of these strains. Thus, strains with high serum resistance displayed low penicillin resistance, and with mutational increases in the latter characteristic decreasing resistance to serum occurred. Phenotypic modifications also were observed: bacteria pregrown in non-inhibitory concentrations of penicillin displayed higher resistance to the bactericidal effects of human serum than their sister cells pregrown in plain media.

Exposure of Sh. dysenteriae or E. coli to usually bactericidal concentrations of serum in the presence of 20% sucrose prevented the killing effects; other carbohydrates failed to produce this protection. The sucrose protection was explainable on the basis of corsetting effects of the hypertonic medium, protecting the integrity of the partially wall-deficient, serum-exposed bacteria. This deficiency also expressed itself in the formation of spheroplasts in the sucrose-serum suspensions. The serum spheroplasts were found to differ from penicillin induced spheroplasts in several respects, including an increased stability to osmotic shock and an apparent difference in the site of the lesion in the bacterial wall.

Additional studies with the strains of different serum susceptibility resulted in the recognition of a number of non-bactericidal agents capable of modifying the bactericidal action of human serum in vitro. The susceptibility of the bacteria to serum was found to increase in the presence of low concentration of broth, in the presence of carbohydrates such as glucose, ribose, and galactose, and also in the presence of amino acids such as glutamic acid, aspartic acid, alanine, glycine and asparagine. When it was found that

inhibitors of bacterial metabolism, such as chloramphenicol and certain amino acid analogues decreased bacterial serum susceptibility, it became possible to attribute the just cited enhancing effects to an enhancement of metabolic activity. In contrast, basic amino acids such as lysine, arginine, DAP, histidine and ornithine produced protective effects against serum bactericidins which were of two types: a) dissociable protection which occurred following pre-exposure of the bacteria to the respective basic amino acids in the absence of nutrients, and b) non-dissociable protection following pre-exposure in the presence of nutrients.

The over-all bactericidal serum system was found separable into two distinct stages. The first stage, requiring specific antibody and complement, initiates the reaction without killing; the second stage completes the killing reaction and can be accomplished by ordinarily non-bactericidal, diluted, heated (56° C for 30 min.), absorbed serum.

A correlation between serum resistance and virulence for mice was demonstrated for the Sh. dysenteriae strains. Also, methods for the direct isolation of strains with increased serum resistance were developed, and an inhibitory effect of agar components upon the action of bactericidal serum factors was investigated.

The implications of these findings for a better understanding of bactericidal serum systems, the nature of susceptible bacterial sites, and problems associated with natural resistance have been discussed.

Microfilm \$2.50; Xerox \$8.40. 181 pages.

ISOLATION AND PROPERTIES OF A BROAD SPECTRUM ANTIBIOTIC FROM PENICILLIUM CHRYSOGENUM

(L. C. Card No. Mic 60-1500)

Chilukuri Surya Narayana, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Elizabeth McCoy

A new broad spectrum antibiotic has been produced by a strain of Penicillium chrysogenum isolated from soil and designated No. 427. The antibiotic is active against common gram + bacteria, one species of gram - and acid fast bacteria and certain fungi. Arbitrarily, the unit of activity is defined as the amount contained in 1 ml of solution which gives a zone of inhibition of 20 mm, with B. subtilis as the test organism.

The morphological characteristics of the culture clearly show that it is a typical strain of P. chrysogenum. The original isolate was separated into white and bluishgreen varieties. Both the varieties produce the antibiotic.

The culture also produces penicillin, a phenomenon common to all the isolated strains of \underline{P} . chrysogenumnotatum.

The medium for production was semi-synthetic (containing yeast extract, glucose, ammonium acetate and minerals). The antibiotic is present mainly in broth at the time of harvest, 96-100 hr, and the pH about 7.2. No appreciable amount of antibiotic is extractable from the mycelium.

As the main interest of the investigation is not penicillin,

it is first destroyed by penicillinase and the new antibiotic is then extracted with ethyl acetate from acidified broth at pH 2.0. The ethyl acetate extract is washed with 1N NaHCO3 to remove any acidic material. The ethyl acetate extract (free from bicarbonate-solubles) is then shaken with 0.01N NaOH, into which the antibiotic is taken up. The NaOH solution is acidified and extracted with ethyl acetate. The ethyl acetate extract on concentration gives the antibiotic in crude form. The antibiotic was purified by column chromatography, on cellulose and silicic acid and then by partition chromatography on a celite column, with McIlvain's buffer pH 7.0 as the immobile phase and benzene as the mobile phase. The pale yellow powder after the purification steps has an activity of 1 mg = 8 units, or about 10 X the activity of the starting material. This purified product is called the new antibiotic No. 427, for purposes of convenience in the later investigation.

The antibiotic activity is assayed by the paper-disc plate method, with alternative organisms: B. subtilis for the activity against gram + bacteria and G. cingulata for the activity against fungi. In the purified preparation of new antibiotic No. 427 there appears only one component active on both assay organisms, as shown by paper strip chromatograms. Paper chromatography with different solvent systems confirms this fact.

The antibiotic is soluble in ethyl acetate, chloroform, benzene, ethanol, acetone, dioxane and methanol. It is soluble in 1N NaOH, 1N Na₂CO₃, 2N NH₄OH, giving a yellow solution. It is insoluble in petroleum ether and water. The antibiotic is fairly stable at neutral pH, even at 100 C for five minutes.

Biologically the antibiotic is active against all gram + bacteria tested, but only one of the gram - (Agrobacterium tumefaciens) so far tested. It has activity against acid fast bacteria as represented by Mycobacterium tuberculosis 607. It is also positive against some Streptomyces sp. and certain fungi. The antibiotic preparation (in form of purified product with activity of 1 mg = 8 units) did not show any toxicity when injected intraperitoneally into mice or fed to nematodes, Rhabditis sp.

During the investigation it was noted that crystalline penicillin G has some activity against Glomerella cingulata, a common plant pathogen. Previous reports of penicillin inactivity against fungi were primarily on animal pathogens.

The new antibiotic No. 427 is differentiated from penicillin on the basis of: difference in chemical extraction (not passing into the bicarbonate fraction), not inactivated by penicillinase, movement on paper strip chromatogram at pH 7 with ether as developing solvent, different infrared spectrum, and absence of sulfur in the antibiotic.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

ANTIGENIC DIFFERENCES AMONG ASIAN INFLUENZA VIRUSES AS DETERMINED BY HYPERIMMUNE MOUSE SERA

(L. C. Card No. Mic 60-1572)

Robert Richard Rafajko, Ph.D. State University of Iowa, 1960

Chairman: Professor Albert P. McKee

Relatively little experimental effort has been directed toward clarifying the position or determining the extent of antigenic relationship among strains in a given subtype. Still less work has been done to compare the antigenic makeup of strains causing a given epidemic. The Asian influenza epidemic in the fall of 1957 at the State University of Iowa afforded such an opportunity. The present study was undertaken to determine if any antigenic difference existed among A" strains causing this epidemic.

The problem was approached by hyperimmunizing mice with six representative A" strains. The subsequent antisera were cross-titrated by means of the HAI, CF, and neutralization tests.

Mice were chosen for immunization because their serum lacks the troublesome nonspecific inhibitors found in most animal sera. It was found that high-titered antiserum could be obtained from mice by repeated intraperitoneal injections of increasing quantities of viral antigen. The six A" strains showed varied immunogenicity and the reasons for this are discussed.

Results of the HAI tests with the six A" viruses and their respective mouse antisera showed HAI titers which ranged from 20,480 to <40. All six A" viruses showed a varied sensitivity for HAI antibody. An antibody sensitivity gradient for HAI antibody was demonstrated, with the Horner virus being the most sensitive and the Swenson virus the least sensitive. Two possible reasons for this varied sensitivity to HAI antibodies are discussed in detail as well as the relationship of this reactivity to P-Q-R variation.

Swenson A" virus was inhibited by heterologous mouse antisera to varying degrees in the HAI test, however, the homologous antiserum showed no antibody for the Swenson virus. Despite this the Swenson antiserum demonstrated HAI antibodies against all heterologous A" strains tested.

All A" antisera contained HAI antibodies for the A' strains, FM-1, IA'56, and IA'57. In addition Swenson antiserum contained antibody to the classical A strain, PR8. Antisera developed against PR8 virus showed HAI antibodies only for the homologous and FM-1 strains. The possible implications of these results are discussed.

Neutralization tests between the six A" strains and their respective antisera show all A" strains except Swenson to be very closely related antigenically. The Swenson antiserum contains no neutralizing antibodies for any of the other A" strains. Heterologous antisera, except for Pepino, contain no neutralizing antibodies for Swenson virus.

It was demonstrated that the HAI titer of an immune serum is not necessarily an indication of the quantity of neutralizing antibodies present. The practical implications of this are discussed.

Results of cross-CF tests showed all six A" viruses to be related to each other with little difference in CF titer among various antisera.

Microfilm \$2.50; Xerox \$3.60. 62 pages.

STUDIES ON BACTERIA STORED AT SUBFREEZING TEMPERATURES

(L. C. Card No. Mic 59-6257)

Robert Wright Squires, Ph.D. Purdue University, 1954

Major Professor: S. E. Hartsell

This investigation was conducted to ascertain the effects of freezing on the growth initiation rates of defrosted E. coli. The results can be summarized as follows:

A new method for the estimation of lag time was formulated and tested for validity. This method considered the physiological vigor with which the culture grew during the logarithmic growth phase as well as the time relationship involved. Comparison with the method of Hinshelwood indicated that the new method gave comparable results; furthermore, it had the advantage of being useable in those cases where the slopes of logarithmic growth lines have been altered due to changes in environmental conditions.

Studies were performed to ascertain the effect of additives to menstrua on the subsequent growth initiation rates of defrosted E. coli, 7006. YEVI (Yeast Extract Veal Infusion) broth and Sorensen's M/15 phosphate buffer, pH 7.0 were used as suspending fluids. Additives were 5% (w/v) concentrations of glycerine, gelatin, and soluble vegetable oil

Results indicated that cells which did survive the initial freezing kill had an amazing ability to initiate new growth when inoculated into fresh medium. The shortest lag and generation times were observed after 40-60 days of storage at -9°C. The action of phosphate buffer appeared to lessen the effects of "storage kill" and prevent drastic alterations (make longer) in the growth initiation rates of defrosted suspensions.

The combination of phosphate buffer and glycerine showed excellent survival conditions for cells subjected to subfreezing temperatures (-25°C. then -9°C.). This combination had little effect on changing lag time, but greatly affected the generation time. When glycerine was added to YEVI Broth, the defrosted suspensions showed changes in lag time but not in generation time.

Gelatin gave good protection against storage kill in both suspending fluids. Only moderate changes were

observed in the growth initiation rates of cells when stored with this material.

YEVI Broths, without additives, were shown to be the poorest of the menstrua tested from the standpoint of survival against storage kill. The results for lag and generation times were thought to be typical of the effects of frozen storage on E. coli. Long initial lag and generation times were observed during the early weeks of storage, followed by a gradual shortening of the growth initiation rates until values under normal were observed. After four months of frozen storage, growth initiation characteristics of cells stored in the YEVI (without additives) were again on the increase. Concentrated YEVI Broth had much the same effects on growth initiation as normal strength YEVI medium. However, concentrated medium appeared to lessen the effects of storage kill.

Soluble vegetable oil offered no protection against the effects of freezing under the conditions used in this investigation.

A growth stimulatory substance was isolated from E. coli and termed Factor "S" for stimulation. This material had the biological property of shortening lag times as the concentration was increased.

A chemical fractionation scheme for the isolation of Factor "S" was worked out and an adequate assay method developed for the estimation of the amount of growth promoting substance contained in an aliquot of defrosted, hydrolyzed phosphate buffer.

Many of the physical and chemical properties of Factor "S" were investigated, particularly its solubility characteristics in various organic solvents. Though rather extensively fractionated, the type or class of compounds to which this substance belongs remains unknown. However, it appears to have many of the properties of an essential oil or short chain fatty acid.

Factor "S" was shown to be synthesized during frozen storage and to be utilized by E. coli cells stored at 3°C. Similar growth promoting substances were isolated from non-frozen suspensions of M. aureus, Sal. oranienberg, Sal. typhimurium, and Sh. dysenteriae. The lag times of several gram negative organisms were shortened when grown in T.G.E. broth containing Factor "S". Indications are that Factor "S" is non-specific and is active in the presence of species other than the one that produced it.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

BIOLOGY - GENETICS

PATHOGENECITY OF NATURAL RACES AND INDUCED BIOCHEMICAL MUTANTS OF Colletotrichum lagenarium ELL. & HALST. AND THE INHERITANCE OF RESISTANCE IN CUCURBITS.

(L. C. Card No. Mic 60-1267)

Sisir Kamal Dutta, Ph.D. Kansas State University, 1960

The fungus Colletotrichum lagenarium (Pass.) Ell. & Halst. is a widely recognized pathogen that causes an-

thracnose in the cucurbit species <u>Citrullus vulgaris</u>, <u>Cucumis melo</u>, <u>C. sativus</u>, <u>Cucurbita maxima</u>, <u>C. pepo</u>, and <u>C. moschata</u>. Several workers reported natural variation of pathogenecity of this fungus and confusing results were obtained by cucurbit workers regarding the mode of inheritance of resistance. The present studies were undertaken to (1) identify the natural physiological races of the fungus, (2) determine the mode of inheritance of resistance in watermelon varieties and (3) to elucidate the mechanism of variation of pathogenecity by a comparison of biochemical mutants and the wild type.

Single spore isolates were made from different cultures of the fungus and their virulence tested against several commercial varieties and plant introduction lines of watermelon, cucumber, muskmelon, pumpkin and squash. Criss Cross, Charleston Gray and Black Diamond (common susceptible host) watermelon, PI 163213 and Model cucumber were considered as suitable differential host varieties for identification of already-known Races 1, 2 and 3, and also for Race 4 discovered during the course of present investigations. Isolates KS I (Race 3) and NC II (Race 2) were used for subsequent studies.

The inheritance of anthracnose resistance was studied, and it was concluded that resistance in the seedling stage to the KS I isolate behaved as a dominant monogenic factor 'R' in the watermelon varieties Charleston Gray, Congo and Fairfax. Progenies of crosses among three resistant (to KS I) varieties were all susceptible to the isolate NC II. It was proposed that the varieties Charleston Gray, Congo and Fairfax have the same genotype 'RR' for their resistance against the isolate KS I and none of them carried any factors against the isolate NC II.

Biochemical mutants were induced by treating conidia from the selected standard virulent isolate NC II with the ultraviolet radiation. Mutants requiring the amino acids leucine, isoleucine, serine, lysine, histidine, proline, alanine and valine, the vitamin inositol and pyrimidines were found to be avirulent. Mutants requiring the amino acids methionine and glycine were virulent like the wild type and one requiring pyridoxine was found moderately virulent to the varieties Black Diamond watermelon and H.B. 36 muskmelon.

Certain avirulent mutants became virulent temporarily producing anthracnose symptoms within seven to ten days, when the respective supplements histidine, serine, leucine, isoleucine, proline and inositol were supplied in aqueous solution to the surface of the leaves of inoculated Black Diamond watermelon seedlings. However, the virulence of the nonpathogenic mutants which required pyrimidines could not be restored. In a preliminary experiment, all natural isolates and mutants except those requiring pyrimidines grew in whole tissue homogenates of all resistant and susceptible varieties tested. Differential growth responses of the natural isolates and mutants, however, were observed when placed in extracts from the epidermal layers of stems and leaves of resistant and susceptible varieties. It was reported by other workers that the fungus penetrates the cuticle and apparently utilizes epidermal tissue as nutrition for initial growth and establishment in the host. These observations support the hypothesis that mutants were avirulent because of an inadequate nutrition supply or effective inhibition at the site of inoculation. It is probable that this mechanism may be happening in nature, and would be possible in determining the differences in degree of anthracnose susceptibility shown by different commercial varieties and plant introduction lines of cucurbits.

Microfilm \$2.50; Xerox \$3.80. 70 pages.

A RECESSIVE TYPE OF IMMUNITY TO VIRUS X IN SOLANUM TUBEROSUM L.

(L. C. Card No. Mic 60-1494)

Hari Kishore, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor G. H. Rieman

Potato virus X infection has been reported to cause considerable reduction in yield of the crop of the common potato (Solanum tuberosum L.). Its control is necessary to prevent this loss. One of the best methods of control of any disease is through host resistance. In S. tuberosum two types of resistance (hypersensitive and immune) against this virus is recognized. In the varieties hypersensitive to virus X, hypersensitivity is controlled by one dominant gene and in the varieties immune to virus X immunity is controlled by two complementary dominant genes, where presence of both as dominant is necessary for immunity.

The investigation presented here deals with the genetic behavior towards immunity to virus X of two S. tuberosum varieties, x 137 and x 143, carrying immunity type of resistance to virus X and related to virus X immune variety S.41956 and one virus X susceptible variety, AG 54.55, of unknown germ plasm for resistance.

The plant population raised from true seeds of S_1 of the three varieties, S_2 from four selections of x 143 S_1 , F_1 of cross with AG 54.55 of x 137 and x 143 and F_2 of seventeen selections of (AG 54.55 X x 143) F_1 were tested for resistance and susceptibility with X^{21} , a ring spot strain of virus X. The preliminary screening was carried by serological precipitin test. Later the individuals showing resistance were tested for virus on Gomphrena globosa L.

An analysis of the segregation ratios for resistance and susceptibility in S₁ of AG 54.55 leads to conclusion that the resistance to virus X in this variety is controlled by a recessive gene in nulliplex condition. This is a new pattern of gene segregation controlling resistance, not recorded thus far, which has been designated c. Along with the locus for complementary genes A and B necessary for immunity, the gene for C is also generally present in S. tuberosum as is evident from the analysis of the data for resistance and susceptibility in S₁ of x 137 and x 143 and F₁ of these two varieties with AG 54.55. The genotypic constitution of AG 54.55 is inferred to be aaaaBbbbCccc.

On the basis of these analyses the genotypic constitution of the immune variety x 143 is established to be AAaaBbbbCCcc, where presence of complementary genes A and B in dominant condition imparts immunity. Gene c when present as homozygous recessive imparts immunity but it does not otherwise affect the expression of complementary genes A and B, and behaves independently. The conclusion on the genotype of x 143 is supported by the analysis of data for resistance and susceptibility of S₂ of selections from x 143 S₁ and also by the results of F₂ of selections from (AG 54.55 X x 143) F₁.

Some deviations from the fixed ratios observed in S₂ and F₂ are attributed to chromatid segregation with double reduction and numerical non-disjunction, alone or with double reduction. This indicates extensive homology between the four chromosomes in which this gene is located.

The genotypic constitution of x 137 appears to be AAaaBbbbCccc from the analysis of the data of S_1 but it also gives a better fit with the data for (AG 54.55 X x 137)- F_1 for the genotypic constitution of AAaaBbbbCCcc. In order to elucidate this and to find out the cause of this variation a critical examination of larger populations of S_1 , S_2 of x 137 and F_1 , F_2 of (AG 54.55 X x137) is desired.

The importance of a recessive gene like c, controlling resistance in a highly heterozygous plant such as potato, is of considerable value for crop improvement. Further a nulliplex gene is a valuable tool for use as a test cross in a study of tetraploid inheritance.

Microfilm \$2.50; Xerox \$3.60. 62 pages.

RECONSTITUTION OF THE VARIEGATED PERICARP ALLELE IN MAIZE BY RETURN OF MODULATOR TO THE P LOCUS

(L. C. Card No. Mic 60-1502)

Elwin Ross Orton, Jr., Ph.D. The University of Wisconsin, 1960

Supervisor: Professor R. Alexander Brink

The mutable variegated pericarp allele (P^{VV}) in maize has been shown previously to be a dual structure composed of the stable P^{rr} allele conditioning self-color and a transposable element termed Modulator (Mp) which, when present at the P locus in conjunction with the P^{rr} allele, inhibits the pigment-producing action of the latter. Modulator frequently undergoes transposition from the P locus to other chromosomal sites. Following the loss of Mp from the P locus, the P^{rr} allele exhibits its normal activity.

Certain self-red mutants from medium variegated exhibit an instability in the expression of the P^{rr} allele in the form of variegated or nearly colorless sectors in the pericarp. An object of the present study was to determine if these sectors result from somatic mutations of P^{rr} to P^{vv}

Most transpositions of Modulator result in relocation of the element at other sites closely linked to the P locus. This fact is interpreted to mean that, in transposing, Modulator tends strongly to move only a short distance along the same chromosome. Based on this premise, it was postulated that the rate of pericarp sectoring of a mutant self-red containing a transposed Modulator (tr-Mp) is a function of the distance of tr-Mp from the P locus. The present study tests this hypothesis.

One hundred and thirty kernels exhibiting a variegated or nearly colorless pericarp phenotype over part or all of the kernel on otherwise red ears were planted in a search for red to variegated mutants. In addition, 23 mutant self-red families were scored for the number of pericarp sectors per 1000 kernels and the linkage of P^{rr} with tr-Mp in an attempt to determine if there is a relationship between the rate of pericarp sectoring and the closeness of the site of tr-Mp to the P locus.

In 17 of these families (10 carrying tr-Mp, 7 lacking tr-Mp) the pericarp sectoring was associated with the presence in the genome of a transposed Modulator. Among the 10 Mp+ families, the rate of sectoring was directly related to the linkage of tr-Mp to the P locus.

Mutant variegated plants were obtained from sectored kernels in 32 independent cases in which the parent redeared individual was found to possess a linked transposed Modulator. Twenty-four of the mutant variegateds were tested for the presence of Modulator, and all proved positive.

These results indicate that the pericarp sectoring observed on self-red ears in these families do, indeed, result from transpositions that return Mp to the P locus.

Several of the medium variegated mutants were indistinguishable from the standard medium variegated which gave rise to the original self-red mutants. The majority of the mutants, however, exhibited phenotypes unlike that of the standard medium variegated. The various phenotypes of these reconstituted variegateds could be due to changes of state of Modulator, to increases in the number of Modulators present, or to different physical associations of Modulator with the Prr allele.

The pericarp sectoring observed in one group of six closely related families was found to be independent of the presence in the genome of <u>tr-Mp</u>. Further study will be required in order to determine the cause of the sectoring observed in this group of families.

Microfilm \$2.50; Xerox \$3.80. 66 pages.

THE GENE ACTION INVOLVED IN THE FERTILITY RESTORATION OF TEXAS TYPE CYTOPLASMIC MALE STERILE MAIZE AND ITS PERFORMANCE COMPARED WITH NORMAL CYTOPLASM

(L. C. Card No. Mic 60-1509)

Birkbeck Stead, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor N. P. Neal

The use of cytoplasmic male sterile seed parents and restorer pollen parents offers a practical method of eliminating detasseling in seed production of hybrid maize. The present study involved the determination of the gene action in fertility restoration of cytoplasmic male sterile hybrids. Some inbred lines restore full fertility when crossed with male sterile seed parents while others give a variable or partial restoration. An attempt also was made to ascertain if different cytoplasmic backgrounds affected the expression of similar genotypes.

The investigation involved crosses of seven restorer inbreds, three partial restorer inbreds and six Texas type male sterile inbreds and their normal counterparts. The gene action of fertility restoration was studied by a test for allelism of the restorer genes in the different inbreds by testing male sterile x (restorer inbred x restorer inbred) crosses. The segregations of F2 and back-cross generations of male sterile x restorer inbred crosses were also observed.

Yield, moisture at harvest, plant and ear height and number of days respectively to silking and pollen shedding of single crosses between male sterile and normal counterparts of inbreds crossed with restorer inbreds, were compared to establish if the type of cytoplasm affected these attributes. The results clearly showed that non-allelic genes were acting respectively for the seven inbreds that affected full restoration and for the three that gave only partial restoration. In the former only a single gene was involved, whereas in the latter two complementary genes were necessary. Three of the male sterile inbreds were homozygous for one of the complementary partial restorer genes while the other three required both partial restorer genes to produce viable pollen.

Segregations involving the restorer genes tended to produce fewer sterile plants than expected, when the pollen parent of the segregating generation produced both restorer and non-restorer pollen. This appeared to be due either to a differential development or to a competitive advantage of restorer pollen. The extent of the deficiency of sterile plants was dependent upon the restorer inbred involved.

The interpretation of segregation ratios involving partial restorer genes is somewhat speculative due to the considerable number of semi-fertile plants that genotypically were shown to be either fertile or sterile. The expression of partial fertility restoration in crosses was affected by the modifier complexes of both the partial restorer inbred and by the male sterile inbred involved. Where the modifiers of a specific combination produce a low degree of restoration in the single cross, difficulty was experienced in interpreting the gene action involved in the segregating generations.

The comparisons of similar single crosses with Texas type male sterile cytoplasm and normal cytoplasm showed no consistent differences that could be attributed to the cytoplasmic type involved. Four to six backcrosses to the normal parent apparently were insufficient to consider the male sterile inbred iso-genic with its normal counterpart, since significant differences between the two versions, not attributable to sterility or to the cytoplasmic type, could be measured. A comparison of fertile and sterile segregates sampled in backcross populations showed no difference in yield but fertile plants had greater ear and plant height.

It was concluded that two gene systems independently were capable of restoring fertility on Texas male sterile cytoplasm. In the material studied only a single gene was needed to restore complete fertility while two complementary genes which were greatly influenced by modifiers were responsible for partial fertility restoration. The presence of Texas type male sterility in crosses did not affect the attributes measured in comparison with normal cytoplasm.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

A STUDY OF THE CHROMOSOME NUMBER, MICROSPOROGENESIS, MEGASPOROGENESIS, EMBRYO SAC DEVELOPMENT, AND EMBRYOGENY IN BLACK GRAMAGRASS, BOUTELOUA ERIOPODA (TORR.) TORR.

(L. C. Card No. Mic 60-1252)

L. J. Streetman, Ph.D. University of Arizona, 1960

Supervisor: Lee S. Stith

The chromosome number, microsporogenesis, megasporogenesis, embryo sac development and embryogeny of B. eriopoda were investigated. Thirty-five accessions were observed for chromosome number and meiotic behavior. Plants of the "Flagstaff" strain, considered to be the standard black gramagrass, were used in the remaining phases of the study.

The plants were grown at the University of Arizona Plant Material Center, Tucson, Arizona. Laboratory facilities were also located at this installation.

Chromosome counts were made using pollen mother cells after repeated attempts using root tips had failed. Difficulties encountered with root tips were the lack of healthy tips, the low frequency of metaphase cells, and the tendency of the small chromosomes to clump.

Preliminary studies to facilitate collection of pollen mother cells showed the peak pollination period to occur between 4:30 and 6:30 p.m. This period was found to vary slightly with different climatic conditions. Inflorescences completely emerged from the boot collected one to two hours before pollination yielded the desired meiotic cells.

Thirty-four of the 35 accessions studied had a diploid chromosome complement of 2N = 20. Meiotic behavior of these plants was normal, and pollen quality approached 100 per cent. One accession had an aneuploid chromosome number of 2N = 28. Chromosome association at diakinesis of these plants ranged from a maximum of seven trivalents, three bivalents, and one univalent to a minimum of four trivalents, six bivalents, and four univalents. Metaphase I and anaphase I cells had from one to eight lagging chromosomes. Pollen quality was approximately 67 per cent; however, the plants were highly sterile. The results of this phase of the study furnishes evidence for a basic chromosome number of x = 10 for the genus Bouteloua rather than the originally proposed x = 7.

A detailed analysis of megasporogenesis and embryo sac development was made by studying progressively older florets. The megagametophyte was found to develop in a perfectly normal manner, the end result being an 8-nucleate embryo sac of the "Polygonium" type. The two polar nuclei normally fused before fertilization. The antipodals and synergids disintegrated and were digested by the time of fertilization. Abnormal development of nucellar tissue was not detected and embryo development did not begin until 12 to 18 hours after anthesis. The normal development of the female gametophyte indicates reproduction to be sexual. A high degree of variability among and within accessions not only afforded further evidence for sexual reproduction but also suggested that the species was largely cross-pollinated.

The proembryo of black gramagrass, which began development 12 to 18 hours after pollination, was found to

lack a discernible arrangement of cells and sequence of division. The endosperm was free nuclear until four days after pollination when it changed to a cellular form. Differentiation of the proembryo into various structures began four to five days after pollination. The embryo matured anatomically 12 days after pollination. The mature embryo had a very prominent multicellular suspensor and shield-like scutellum.

In the course of the embryological study, insect eggs or embryos were found embedded in the ovary tissue. The identity of the insect could not be established. The time of infestation could not be definitely determined; however, damage was not detected until three days after pollination. Fifty per cent of the ovaries examined showed damage, suggesting that this insect could greatly reduce black gramagrass seed production.

Microfilm \$2.50; Xerox \$3.00. 55 pages.

GENETIC FINE STRUCTURE OF THE PYR-3 LOCUS OF NEUROSPORA CRASSA

(L. C. Card No. Mic 60-1273)

Yoshitaka Suyama, Ph.D. Kansas State University, 1960

The gene of the classical genetics has been characterized by the properties of mutation, recombination and function. These properties, collectively, were at first thought to be qualities of one and the same unit of heredity, the gene. In recent years, however, considerable evidence for complexity of genetic loci has been accumulated in a variety of organisms, particularly microorganisms. The classical gene now appears to be subdivisible into smaller elements, by recombination and by new functional criteria. In view of such evidence the question has been raised as to whether the criteria used to define a gene describe one or three different entities of heredity. Furthermore, recent investigations have suggested that perhaps some mechanism other than conventional crossing over are responsible for intraallelic recombination. The study of complex loci and heteroallelism in particular is therefore to ask, first, "what is the limit of hereditary material to be recombined," and second "what is the mechanism for intraallelic recombination?" and third, "what is this relationship between the ultimate functional unit and the ultimate mutational and recombinational unit?" The present investigation is an attempt to extend the intraallelic genetic analysis of the Pyr-3 locus of Neurospora crassa and to elucidate the nature of heteroallelism as well as the mechanism of intraallelic recombination.

The Pyr-3 locus is located 15 map units from the centromere on the right arm of the linkage group IV, and the mutants at this locus appear to be blocked at a biochemical step prior to the ureidosuccinic acid synthesis in the pyrimidine metabolism. Thirty-three Pry-3 mutants were isolated following U.V. irradiation, and studied by mutant x mutant crosses, three point crosses, tetrad analysis and heterokaryon complementation.

Crosses between some mutants gave rise to wild-type recombinants (prototrophs) and the maximum frequency was found to be ca. 2 x 10-4. As assessed from the frequencies of the prototrophs, the Pyr-3 locus was found to be composed of at least 13 genetic sites. These sites were genetically additive and can be arranged in a one dimentional array in much the same way as different loci can be arranged in a linear order. Three-point crosses, using a colonial marker, located one map unit proximal to the Pyr-3 locus, have shown intense "negative interference." Furthermore, it was found that reciprocal crosses did not retain the uniform mode of asymmetry in terms of the percent of colonials among prototrophs as expected from the linearity of the sites. This may be an indication that a point of physical disorder exists within the Pyr-3 locus. The occurrence of "negative interference" and its significance was further studied by tetrad analysis in a cross using markers proximal and distal to the Pyr-3 locus. Only two asci out of 5,674 dissected contained prototrophs and both were aberrant in a sense that the conventional crossing over could not account for their genotypes.

By the use of heterokaryon complementation studies it was found that the Pyr-3 locus could be divided into two functional groups, one containing two genetic sites and the other 11. The functionally divisible point appeared to coincide with the point of the physical point of disorder previously mentioned. However, the degree of complementation is not a function of the distance between the sites.

These combined results suggest that non-reciprocal crossing over occurs in such a predictable way that the linearity can be obtained among the sites and no discontinuity exists between two functional groups. Furthermore, the one dimentional structure of the locus is not necessarily parallel to the orientation of chromosome. A probable fine structure of the locus is presented.

Microfilm \$2.50; Xerox \$3.00. 51 pages.

BOTANY

INFLUENCE OF NITROGEN, PHOSPHORUS, AND TEMPERATURE OF CERTAIN PHASES OF GROWTH OF CORN.

(L. C. Card No. Mic 60-1482)

Noazesh Uddin Ahmed, Ph.D. The University of Wisconsin, 1960

Supervisors: Professor Robert H. Andrew and Assistant Professor W. F. Millington

This study is an attempt to interpret performances of corn hybrids and their parental lines by measuring effects of specific environmental factors on top and root growth, during the first six weeks of development. The environmental factors considered are nitrogen and phosphorus level, temperature level and diurnal temperature variation under otherwise constant conditions. The corn genotypes of economic importance here considered are two sweet, two flint, two early dent and two late dent inbred lines and their respective single hybrids. The studies were made using both soil and solution cultures, the solution cultures permitting continuous observation of root development. Plant growth is expressed in terms of fresh and dry root and top weight, in terms of top-root ratio and by number of permanent adventitious roots. The top-root ratio has proven to be a useful measure in evaluating plant development. A technique was worked out for tracing the continuous development of individual plants growing in nutrient solution.

This study shows:

- 1) All four types of corn had different top-root ratios, and further, each type had both high and low top-root ratios of distinct orders of magnitude.
- 2) For the hybrids the top-root ratio tended toward that of the low top-root ratio parent, even though the actual dry weight of the hybrids was greater than that of either parent.
- 3) Flint and sweet lines had higher top-root ratios than the dent lines.
- 4) Low nitrogen level reduced the top-root ratio for all genotypes. This decrease is caused primarily by reduced top growth.
- 5) Low phosphorus level reduced the top-root ratio for all genotypes, and to a greater extent in the high ratio inbreds. This decrease is caused primarily by reduced top growth.
- 6) Constant 80°F temperature increased the top-root ratio by retarding the root growth as compared with growth under alternating temperature (68° to 88°F).
- 7) Alternating temperatures of 58° to 78°F decreased the top-root ratio by retarding the top growth as compared with growth under alternating temperatures of 68° to 88°F.

- 8) Environmental changes have a less significant influence on top-root ratios in the low ratio genotypes.
- 9) The top-root ratio varies inversely as the number of permanent adventitious roots.
- 10) All hybrids had higher early growth rates than their inbreds. Microfilm \$2.50; Xerox \$5.80. 118 pages.

THE SOIL MICROFUNGI OF CONIFER-HARDWOOD FORESTS IN WISCONSIN

(L. C. Card No. Mic 60-1486)

Martha Christensen, Ph.D. The University of Wisconsin, 1960

Supervisors: Professors Myron P. Backus and John T. Curtis

A survey study of soil microfungal populations from 36 conifer-hardwood forests in northern Wisconsin has been carried out. The study is an extension of earlier investigations conducted by Tresner and Orpurt, respectively, in prairie and southern hardwoods regions of the state.

One hundred and eighty isolates per forest were obtained by the dilution plate method, and lists of the species present and their frequencies of occurrence were prepared for each sample population.

The 6,461 isolates were considered to represent 482 entities, of which 71 percent occurred in single forest communities; but the four most frequently isolated forms -- Mortierella vinacea var. 400, Trichoderma viride, Mortierella isabellina, and Penicillium nigricans-- constituted 41 percent of the isolates. Other species present in one-half or more of the communities sampled were Mortierella nana, Pullularia pullulans, Masoniella sp., Penicillium janthinellum, Paecilomyces carneus, Oidiodendron fuscum, and O. flavum. Trichoderma viride and Penicillium nigricans have been isolated from forest and prairie soils throughout the state; five of the above occur in similar higher plant communities in northern and southern Wisconsin; and four appear to be restricted to northern conifer-hardwood soils.

Species composition and quantitative values for shared species varied in the 36 microfungal communities. Expressions of the differences were obtained using Gleason's coefficient of similarity, and the communities were then ordinated along three axes, following the methods of Curtis and of Beals. The discovery that forests with similar tree dominants held positions near to one another within the three-dimensional microfungal ordination confirmed the hypothesis that species composition in soil microfungal communities is correlated with species composition in the cover vegetation.

The microfungal communities of least similarity were those from a hemlock forest soil and from a maple forest soil. These were positioned at opposite ends of the first axis; environmental correlates with that axis were found to be litter base content and podzolization intensity. The second and third dimensional view of the microfungal community ordination strongly resembles Curtis' two-dimensional ordination of northern Wisconsin forests based upon higher plant composition.

In an attempt to illustrate environmental responses in the separate microfungal species, frequency values for 93 leading species were plotted against the two gradients figuring most prominently in the ordination -- Brown and Curtis' forest ordination based upon tree dominants, and the fungal first axis (podzolization gradient). Sixty-five species occupied restricted ranges in the spectrum of forest types. Ten of 28 broad amplitude species had welldefined frequency crests along the forest continuum, fourteen showed significant correlation with the fungal first axis gradient, and only four species appeared to be sporadically distributed. Thus, soil microfungi in northern conifer-hardwood forests exhibit ascendency patterns within a multidimensional environmental complex; podzolization intensity and tree dominant differences parallel compositional variation in the microfungal communities. Indirect evidence of an antibiotic interaction effect within the microfungal communities also was obtained.

The number of microfungal species per forest ranged from 11 to 51; greatest numbers of species were obtained from soils supporting both conifer and broadleaved tree dominants. Isolate densities for Penicillia also were highest in mixed forests, but Mucorales were most abundant in predominately coniferous stands.

Plate counts of microfungi--high in oak soils, low in maple soils--were shown to be a direct reflection of number of viable spores present in the soil suspension. Bacteria and actinomycete densities were highest in maple soils.

Descriptions of 44 new or noteworthy fungi from the northern forest soils are contained in a second major section of the dissertation. Included are three new Penicillia, two new species in the genus Masoniella, forms in a Mucor ramannianus-Mortierella pusilla complex, five Oidiodendron species, and three interesting Aspergilli peculiar to acid sandy soils.

Microfilm \$5.80; Xerox \$20.50. 454 pages.

CINE-MICROGRAPHIC STUDIES OF MITOSIS IN TRADESCANTIA STAMINAL HAIR CELLS (TREATED AND UNTREATED)

(L. C. Card No. Mic 60-820)

Clarence M. Flaten, Ph.D. Indiana University, 1959

THE PROBLEM

The purpose of this investigation was to study in detail the mitotic behavior in the living staminal hair cells of Tradescantia paludosa (2n), and Tradescantia ohioensis (4n). The pattern of mitotic events as it occurs under the conditions of this study was first established for the untreated cell. Analyses were than made of the mitotic

behavior in cells treated with colchicine or gammexane. The occurrences during mitosis of such treated cells were compared with the events of mitosis in untreated cells.

PROCEDURE

The details of mitosis were recorded by means of a phase microscope and time-lapse camera. The staminal hairs were mounted in a cell chamber which permitted a constant flow of medium around the cells. During the colchicine or gammexane runs, the chemical was added to the medium.

Two methods of film study were used, (a) a frame by frame analysis of individual micrographs, and (b) observations of the time-lapse photographs under acceleration (x64).

SUMMARY AND CONCLUSIONS

A. UNTREATED CELLS

The early metabolic nucleus is plastic and pliable.
 By early prophase it has become more rigid and firm.

2. At the end of prophase a number of events occur in close sequential order. These are: (a) the sudden slowing down and near cessation of cytoplasmic movement, (b) formation of clear areas (polar caps), (c) an expansion of the nucleus, (d) the disappearance of the nuclear membrane--probably concomitant with nuclear expansion, (e) the contraction of the nucleus immediately following expansion, (f) disappearance of the nucleolus, usually during contraction or shortly after.

3. Chromosomes became active at the beginning of prometaphase. The assumption is made that prometaphase movements result from two factors: (a) centromereinduced movements which are random in character, and (b) a gradual restriction of these movements towards the center of the cell by the development of an oriented gel which begins in the polar regions and grows inwardly.

4. The metaphase stage is very brief.

- 5. There are four important aspects of chromosome separation during anaphase, all of which are probably necessary for complete separation in Tradescantia.

 These are: (a) a sudden separation of the chromatids occurring simultaneously in all the chromosomes and along their entire length except at the centromere region, (b) the movement of the centromeres to the poles following separation at the centromeric regions, (c) spindle elongation, a phenomenon which has not been previously reported in Tradescantia, (d) contraction or shortening of the chromosome arms.
- 6. Anaphase chromosomes may move on a broad front, indicating that concentrated polar centers are not necessary to centromere movement.

B. COLCHICINE-TREATED CELLS

- 1. Low concentrations (.01% to .05%) of colchicine applied early in prophase induced C-mitosis during prometaphase and metaphase stages.
- 2. High concentrations (1.0%) applied in late prophase or prometaphase caused a disorganization of the spindle during late anaphase.
- 3. Clear area formation appeared to be inhibited by colchicine.
- 4. No effect on the contraction stage was noted, though in one cell the chromosomes remained in the contraction stage for an abnormally long time.

C. GAMMEXANE-TREATED CELLS

- 1. C-mitosis was induced only during the prometaphase and metaphase stages.
- 2. Weakened and delayed contraction was noted. In one run, nuclear contraction did not occur.
- 3. Both colchicine and gammexane treatments induced nuclear fragmentation. However, only one instance was found in gammexane treated cells. Fragmented metabolic nuclei were unable to fuse.
- 4. Mitochondrial clumping occurred to a minor extent during division in untreated cells. However, the condition appeared to be more accentuated in cells recovering from colchicine treatment and even more so in gammexane affected cells.

Microfilm \$3.10; Xerox \$10.80. 237 pages.

AN EXPERIMENTAL STUDY OF SCLEREID FORMATION IN THE LEAF OF CAMELLIA JAPONICA

(L. C. Card No. Mic 60-1294)

Donald Edward Foard, Ph.D. North Carolina State College, 1960

Supervisor: Ernest Ball

Sclereids in developing leaves of C. japonica mature first along the midvein, at the bases of the glandular teeth, and finally along the margins from apex to base. Detached immature leaves will form sclereids on a medium containing only mineral salts and from about 0.06 molar to approximately 0.20 molar sucrose, glucose or fructose. Sclereids are not formed by leaves cultured on approximately 0.5 molar concentrations of these sugars. Callus cultures derived from parenchyma of mature and immature petioles do not form sclereids, when cultured on the several media employed. Sclereids form along incised margins of immature leaves, but not mature leaves. It is concluded that the formation of the idioblasts is determined by their position in the organism as a whole.

Microfilm \$2.65; Xerox \$9.25. 201 pages.

CHEMISTRY

CHEMISTRY, GENERAL

AN ANALYSIS OF CHEMISTRY TEXTBOOKS USED IN THE AMERICAN SECONDARY SCHOOLS BEFORE 1890

(L. C. Card No. Mic 60-1339)

Peter William Mangery, Ed.D. University of Pittsburgh, 1959

The purpose of this study was to analyze the chemistry textbooks used in the American secondary schools before 1890. Twelve of the chemistry textbooks examined were published during the 1784-1815 period; 18 in the second period, 1816-1840; 18 in the third period, 1841-1865; and 21 in the fourth period, 1866-1890. It was found convenient and expedient to divide the total period, 1784-1890, into four periods in order to determine a truer picture of their evolution.

The historical-documentary method of research was employed, developing and using a check list to gather information relative to analysis of the elements of the problem. The selection of textbooks used in the secondary schools of America was based upon information as stated in the author's preface, introduction, publisher's advertisement, teaching aids, and instructional content material, as well as the overall impression of the textbook. More than 100 early chemistry textbooks were examined. Sixtynine apparently were used in secondary schools and so were carefully analyzed as being representative of the period 1784-1890.

A separate check list was filled out for each of the 69 texts. Tables were organized and arranged in chronological order, and in appropriate areas. Summary tables covering the four 24-year periods for comparative purposes were also prepared. Pertinent facts were adduced from the tables and incorporated in the various chapters of the dissertation.

The aims of the authors were as diversified as their professions. In the main, however, their aims were chiefly "subject-centered," and not "child-centered."

Nine different types of organizations of subject matter prevailed in the textbooks for the years 1784 through 1890. Although these various organizations of subject matter were in evidence, the early texts were written without any real approach to psychological organization.

From 1784 through 1865, subject matter content in the early chemistry textbooks increased voluminously. From 1866 through 1890, a period of textual condensation was in evidence. A deletion of irrelevant materials, and revision of texts halved the number of textbook pages from the three previous periods.

As early as 1788 the authors of chemistry texts fully recognized the value of illustrations, and learning and teaching aids. Ninety-four per cent of the texts utilized an average of 108 pictures per book, and 16 learning and teaching aids.

The critical analysis of the 69 texts revealed the following conclusions:

Chemistry was first introduced for its practical value rather than for its theoretical development.

The unanimous aim proposed for achievement by the authors of the 19th-century textbooks was to acquaint the students with the theories and facts of chemistry. This intrinsic aim was consistent with the educational beliefs of the time.

Subject matter content of the secondary chemistry textbooks, basically, remained somewhat static from about 1840 to 1890. Many of the topics, statements of facts, definitions, simple classroom demonstrations and experiments, and examples have remained largely unchanged for more than 100 years.

The Industrial Revolution of this country added its impact to the field of chemistry, and vice versa. As progress and development "bellowed" forth, so too were these scientific acquisitions manifested in the contents of the chemistry textbooks of the day.

Finally, the influences of the practical discoveries of the ancients and the alchemists left their imprint on scientific chemistry. The alchemists inherited all the arts and processing experiences of the ancients, and in turn the early chemists reaped the chemical harvest of their predecessors.

Microfilm \$3.90; Xerox \$13.75. 302 pages.

PART I: SEPARATION BY CATION EXCHANGE
OF THORIUM, ZIRCONIUM, IRON AND URANIUM.
PART II: ION EXCHANGE EQUILIBRIUM
STUDIES FOR URANIUM (IV), THORIUM AND
CADMIUM AND CHROMATOGRAMS
FOR URANIUM (VI).

(L. C. Card No. Mic 59-808)

Saif R. Samedy, Ph.D. University of Colorado, 1958

Supervisor: Professor Harold F. Walton

Thorium, zirconium and iron were separated by absorbing a mixture of the three components on a column of Dowex-50 and eluting each preferentially as follows: iron was stripped first with 1 N HCl, the eluant was then changed to 3 N HCl to elute the zirconium. The column was washed with 50 ml 1 N NH₄ NO₃ and about 250 ml distilled water to transform the resin into the ammonium form and then thorium was eluted with 1% Na₂H₂Y (sodium salt of ethylene diamine tetraacetic acid). The transformation of the ResH to the ammonium form was necessary to prevent precipitation of the acid, EDTA. The elution curves were followed by analyzing appropriate fractions colorimetrically. Quantitative determinations were made by precipitating and igniting as ThO₂, ZrP₂O₇ and Fe₂O₃.

The percent recoveries of Th, Zr and Fe from the resin were 97.5, 96.3 and 96.8 respectively.

Uranium and iron were also separated by cation exchange column technique. After absorbing a mixture of U (VI) and iron on a column of Dowex-50, which was washed with ammonium nitrate and distilled water, uranium was eluted with 2% Na₂Co₃ (uranium forms a stable anionic complex with carbonate). The column was washed with distilled water to remove any adhering carbonates and then elution was continued with 1 N HCl to strip the iron. The column had to be in the ammonium form, rather than the hydrogen form, to prevent formation of H2CO3 during the elution, which would have decomposed to CO2 and decreased the flow rate considerably. Quantitative determinations were made by precipitating uranium with 8hydroxyquinoline as UO2Q2. HQ and iron as Fe2O3. The amount of uranium and iron recovered were 94 and 96% respectively.

The shape of an elution curve (chromatogram) depends on a number of factors such as the operating conditions, the concentration of the eluant, concentration of the absorbed ions, etc. Studies were made to determine qualitatively these effects by absorbing 2.50 grams of UO2(NO3)2. 6 H2O on a cation exchange bed (Dowex-50, 4% cross-linking, 50 - 100 mesh) and eluting it with various concentrations of perchloric acid, under constant operating conditions. The eluants used were 0.5, 1.0, 2.0 and 4.0 M HClO4. The concentration of the absorbed ion (UO2++) was varied from 2.50 to 0.050 gram of uranium nitrate. The results may be summarized as follows: 1) the uranium elution curves were not symmetrical with higher concentrations of the absorbed ions, 2) the curves became more symmetrical with lower concentrations of the absorbed ions, 3) an increase in the concentration of the eluant resulted in higher peaks and narrower bands, 4) the volume of the effluent to the peak was proportional to reciprocal of H ion concentration in the eluant.

Equilibrium studies were made for the U (IV)-ResH exchange in 1 M H₂SO₄, Th-ResH in 6 N and 12 N HCl and Cd-ResH exchange. Approximate equilibrium constants were calculated and the results indicated that the exchange did not obey the law of mass action. The Cd-ResH exchange studies were done at 4, 25 and 50°C. The results showed greater absorption at higher temperatures.

Other results may be summarized as follows: 1) zirconium could be eluted with 1 N HCl from IR-120, but not from Dowex-50, 2) higher temperatures did not seem to favor elution of zirconium and thorium from a cation exchange bed with HCl, 3) both Fe (III) and U (VI) could be eluted from Dowex-50 bed with 1 N HCl, 4) U (IV) is absorbed by Dowex-50 more strongly than U (VI).

Microfilm \$2.50; Xerox \$6.20. 127 pages.

CHEMISTRY, ANALYTICAL

SOLVENT EXTRACTION OF GROUP II METAL 8-QUINOLINOLATES

(L. C. Card No. Mic 60-1337)

Stanley John Jankowski, Ph.D. University of Pittsburgh, 1959

The Group II metals are not readily extracted into chloroform from aqueous solution as their 8-quinolinol chelates. Recent investigations have shown that magnesium is quantitatively extracted into chloroform as its 8-quinolinol chelate when the extractions are carried out in the presence of butyl Cellosolve or n-butylamine.

The purpose of this investigation is to extend the use of 8-quinolinol for the extraction of other Group II metals. The possibility of using modified organic solvents for the extraction of Group II metals has been studied. Secondly, this investigation was undertaken to study the possibility of changing the nature of the metal 8-quinolinolate so as to form a species that is more readily extracted than is the neutral 8-quinolinolate chelate.

The extraction studies were carried out by shaking chloroform solutions of 8-quinolinol in contact with aqueous solutions of the metal ion for periods of time required for attainment of equilibrium conditions. The aqueous phase also contained a water miscible organic solvent such as butyl Cellosolve or ethanolamine or a quaternary ammonium salt such as tetra-n-butylammonium iodide. The effect of these on the extraction behavior of the metal was studied.

Calcium is 97.5 per cent extracted into chloroform as its 8-quinolinol chelate in the presence of butyl Cellosolve. Magnesium is quantitatively extracted into chloroform as its 8-quinolinol chelate in the presence of isoamyl alcohol or ethanolamine. The absorbance of the organic phase after extraction of the magnesium may be used for the determination of magnesium when measured at 380 m μ relative to a blank prepared in a similar manner. Barium and strontium are not extracted as their 8-quinolinolate chelates in the presence of butyl Cellosolve, isoamyl alcohol, or ethanolamine. The procedure was found to be unsuitable for the extraction of zinc and cadmium.

Magnesium, zinc, and cadmium are quantitatively extracted from aqueous solutions of their metal ions into chloroform as their tetra-n-butylammonium 8-quinolinolate complexes. Small amounts of butyl Cellosolve are required to prevent precipitation of the zinc and cadmium complexes after separation of the phases. Calcium, barium, and strontium are not extracted over the same pH range found suitable for the extraction of magnesium, zinc, and cadmium. Thus magnesium, zinc, or cadmium may be quantitatively separated from calcium, barium, or strontium. The absorbance of the organic phases after the extraction of magnesium, zinc, or cadmium may be used for the determination of these metals when measured relative to a blank prepared in a similar manner. The addition of complexing agents such as tartrate and thiocyanate to aqueous solutions of the metal ions indicate that magnesium can be separated from zinc or cadmium and zinc can be separated from cadmium as their tetra-n-butylammonium 8-quinolinolate complexes by extraction into a chloroform-butyl Cellosolve solvent system.

8-Quinolinol undergoes chemical reaction in the

presence of tetra-n-butylammonium iodide and chloroform when contacted with 0.1 N sodium hydroxide solution. The major product resulting from the reaction is 8-quinolinol-7-aldehyde. Microfilm \$2.50; Xerox \$5.20. 101 pages.

A SEQUENTIAL ION EXCHANGE SEPARATION SCHEME FOR THE IDENTIFICATION OF METALLIC RADIOELEMENTS

(L. C. Card No. Mic 60-1501)

Eugene Donald Olsen, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Walter J. Blaedel

There is a need for a rapid method of separating complex mixtures of radioelements into smaller groups of elements, so that the individual elements can be identified. The sequential ion exchange group separation scheme described was designed for this purpose, and rapidly separates a good number of metallic radioelements, in tracer amounts, into smaller groups of elements. The thesis is concerned only with the separation of the groups. The further separation of large groups, and the identification of individual elements within groups, are subjects for future work.

About $3\frac{1}{2}$ hours are required to process a sample by the sequential separation scheme, which separates over 35 elements into 6 groups. The procedure consists of a batchwise sample pretreatment, designed to put the sample into a particular oxidation state, and to complex some elements into anionic form. The pretreated sample is then put onto a column filled with Dowex 50W, and initial washing removes the largest anionic group of 17 elements, consisting of the platinum metals and many trivalent metals. The remaining groups in the sample are then removed from the column in fractions by eluting successively ("sequentially") with various complexing solutions, each of controlled pH and ionic strength. The divalent metals (Cu, Zn, Co, etc.) are removed as the second group, the lanthanides and Y make up the third group, the alkaline earths are in the fourth, Na, Ba, and Tl (1) are in the fifth, and the alkalies are removed in the last group. The main portions of the elements in each group are obtained in 15-30 ml. of solutions containing only ammonium salts, organic acids, or HCl. The conditions necessary for these separations were studied in detail.

The procedure was designed to give clean separations. Of the 38 metal tracers tested, 32 are well separated; each of these elements goes predominantly into one group, and less than 1% falls in any other group. Two elements (Ga, and Tl) are poorly separated; up to 10% of these elements fall into groups other than the group into which each predominantly falls. Four elements (Pd, Au, Hg, and Ag) cannot be tolerated in the scheme.

Less importance was given to obtaining high yields of these elements. Nevertheless, the yields of 27 elements are over 90%, and 3 more are obtained with yields above 80%.

Chlorine is used in preoxidation of the sample and as a holding oxidant. To permit survival of chlorine in solution, prechlorination of the resin is necessary. Detailed studies on resin chlorination were made. Contrary to reports in the literature, the strong acid capacity is decreased, and is accompanied by an almost equal increase in the number of weak acid groups. (Weak acid groups on the unchlorinated resin were also found.) Other effects of chlorination seem to be nuclear chloride substitution and the formation of pH sensitive chromophoric groups. The effects of chlorinating the resin are small, however, and do not noticeably affect the separation scheme.

Some difficulties were encountered in preliminary attempts to extend the separation scheme to the milligram level.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

THE SEPARATION OF SOME PHOSPHORUS ACIDS BY SALTING-OUT CHROMATOGRAPHY

(L. C. Card No. Mic 60-1446)

Kee-Chae Park, Ph.D. Rutgers University, 1960

Major Professor: Wm. Rieman III

The purpose of this investigation was to develop a method for the separation and analysis of mixtures of 18 organic acids of phosphorus and orthophosphoric acid. The organic acids included monoalkyl esters of alkylphosphonic acids, dialkyl esters of phosphoric acid and methylphosphonic acid. The alkyl groups were methyl, ethyl, isopropyl and n-butyl.

An attempt to use gas chromatography was unsuccessful because of the decomposition of the compounds at the temperature required for volatilization. Anion-exchange chromatography was applied with some success, but it was found that salting-out chromatography with a special sulfonated crosslinked polystyrene resin was most successful.

Elutions at 50° at a flow rate of 0.05 cm. per minute through a 50-cm. column of the resin (capacity = 4.03 meq. per g., 325 mesh, 4% crosslinked), starting with 4M lithium chloride plus 1M hydrochloric acid, followed stepwise by 1M hydrochloric acid, 0.5M hydrochloric acid, and finally pure water indicated that the mixture can be separated as follows:

H₃PO₄
MePO(OH)₂
MePO(OH)OMe + HOPO(OMe)₂
MePO(OH)OEt + EtPO(OH)OMe
MePO(OH)OPr
EtPO(OH)OEt + HOPO(OEt)₂
EtPO(OH)OPr + PrPO(OH)OEt
MePO(OH)OBu + BuPO(OH)OMe + HOPO(OPr)₂
BuPO(OH)OEt + EtPO(OH)OBu
PrPO(OH)OBu
HOPO(OBu)₂
BuPO(OH)OBu

The list above indicates the order of elution. Compounds appearing alone on any one line were isolated from all the others. The listing of two or three compounds on one line indicates that these compounds are not separable from each other by this technique but are separated from all the others. The elution required nine days.

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The analysis of the eluate fractions was accomplished by decomposition of the organic compound with alkaline persulfate and subsequent spectrophotometric determination of the resultant orthophosphate.

The ionization constants of some of the acids were evaluated and the results are used to interpret with appropriate equations the behavior of the several acids in both anion-exchange and salting-out chromatography.

Microfilm \$2.50; Xerox \$4.80. 93 pages.

CHEMISTRY, BIOLOGICAL

IN VIVO INTERACTIONS OF SULFUR CONTAINING AZO DYES AND PROTEINS

(L. C. Card No. Mic 60-1265)

Roger Duane Bauer, Ph.D. Kansas State University, 1960

Three sulfur containing azo dyes related to the known carcinogen dimethylaminoazobenzene (DAB) were prepared and administered in the diets of male albino rats to determine their potency as hepatic tumor forming agents. These dyes were: 4-(4'-dimethylaminophenylazo)phenyl methyl sulfide (p-S-Me-DAB), 4-phenylazophenyl methyl sulfide (p-S-Me-AB) and 2-(4'-dimethylaminophenylazo) phenyl methyl sulfide (o-S-Me-DAB). Of these only p-S-Me-DAB was found to bring about formation of tumors in the livers of rats. Thirteen out of 16 rats fed the dye at 0.06 per cent level were found to possess gross tumors after 20 weeks of feeding. The other two dyes caused only a display of abnormal coloring and texture of liver tissue but no gross tumor formation upon feeding for comparable periods of time. All three dyes were found by colorimetric methods to be bound to the protein of homogenates prepared from livers of rats fed the dye at 0.06 per cent levels for six weeks. Both p-S-Me-DAB and p-S-Me-AB synthesized with radioactive sulfur-35 confirmed this finding upon administration.

A study was conducted to compare the rate of uptake of p-S-Me-DAB with the parent carcinogenic compound DAB. The time required to reach a maximum level of bound dye has been postulated to be an important factor in determining the potency of a compound as a carcinogen. DAB was found to be taken up at only slightly more rapid rate than p-S-Me-DAB when determined at weekly intervals in the course of a six week experiment.

The intracellular distribution of p-S-Me-DAB was studied by separation of nuclear, mitochondrial, microsomal and supernatant fractions by differential centrifugation techniques. Although quantitative differences did arise, this compound compared favorably with a very potent carcinogen, 3'-methyl-4-dimethylaminoazobenzene, in that the dye was shown to be present in all fractions analysed 24 hours after administration by intraperitoneal injection.

The reduction products of the total dye extracted after hydrolysis of rat liver proteins were studied in an effort to determine the site or sites on the dye molecule for its interaction with the protein. Previously only the portion of the dye containing the -N(CH₃)₂ group or the ring bearing this group was thought to be involved in the tumor forming process. Studies were carried out on the benzene extractable amines obtained after reduction of the bound dye assuming that this represented the portion of the dye not bound to the protein. By use of spectrophotometric analysis, chromatographic methods and especially radioactive tracer techniques, it appears that more than one portion of the azo dye molecule is involved in the interaction with proteins.

Microfilm \$2.50; Xerox \$4.20. 76 pages.

STUDIES OF THE INFLUENCE OF SALTS ON THE ACTIVITIES OF MALIC DEHYDROGENASE AND ACETO-COA-KINASE FROM SPINACH (SPINACEA OLERACEA)

(L. C. Card No. Mic 60-1298)

Andrew Jackson Hiatt, Ph.D. North Carolina State College, 1960

Supervisor: Harold J. Evans

Studies have been conducted to determine the influence of salts on the activities of malic dehydrogenase and Aceto-CoA-kinase which were extracted from an acetone powder of the leaves of spinach (Spinacea oleracea). An apparently homogeneous preparation of malic dehydrogenase was obtained from this source and the procedure for purification is described. The properties of this enzyme were studied with special emphasis on the effects of different concentrations of salts in the assay medium.

The K_M of purified malic dehydrogenase with respect to DPNH and oxaloacetate was determined to be 1.5 x 10⁻⁵ M and 1.8 x 10⁻⁵ M respectively. When phosphate buffer was used at a concentration of 1.3×10^{-2} M the pH optimum of the enzyme was in the range of 7.0 to 7.4. Optimal concentrations of sodium salts of chlorine, fluorine, iodine, bromine, nitrate and phosphate increased the activity of the enzyme by two- to three-fold. Potassium salts of these anions produced similar effects. Sodium salts of univalent cations produced maximum activity at concentrations of 0.033 to 0.040 M. In addition to this, chloride salts of univalent cations produced a second maximum at a concentration of 0.075 M and fluorides produced a series of maxima. The occurrence of the first maximum appeared to be due to a non-specific salt effect while the occurrence of maxima at higher concentrations was specific for Cl or F. Chloride salts of divalent cations produced a two-fold stimulation and optimal concentrations ranged from 0.012 to 0.013 M. This stimulation seemed to be related to the ionic strength of the medium. Sodium salts of organic acids stimulated malic dehydrogenase maximally at an ionic strength of 0.1. Possible mechanisms by which salts exert their influence on this enzyme have been discussed.

Dialyzed extracts of aceto-CoA-kinase required both univalent and divalent cations for activity. The univalent cation requirement was satisfied by K^+ , NH_4^+ or Rb^+ and maximum activity was produced by a 0.04 M concentration of these cations. The K_A values for K^+ , NH_4^+ and Rb^+ were determined to be 9.5 x 10^{-3} , 5.0 x 10^{-3} and 9.6 x 10^{-3}

respectively. Enzyme activity was inhibited when Na⁺ or Li⁺ were added to the standard assay mixture. This inhibition apparently was not due to a competition of these cations with the activating univalent cations. The divalent cation requirement for enzyme activity was satisfied by Mg⁺⁺, Mn⁺⁺ or Ca⁺⁺. Ba⁺⁺ was ineffective as an activator at all concentrations tested.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

PHOSPHOLIPIDS AND THEIR COMPONENTS IN THE NUTRITION AND METABOLISM OF THE BLOWFLY, PHORMIA REGINA (MEIG.).

(L. C. Card No. Mic 60-317)

Ernest Hodgson, Ph.D. Oregon State College, 1960

Major Professor: Dr. H. H. Crowell

The phospholipids of the egg, larva and 0-24 hours old adult of <u>Phormia regina</u> have been examined by chromatography on columns of silicic acid and Hyflo Super-Cel by the method of Hanahan et al.

The total phospholipid content is 1010 micrograms lipid phosphorus per gram dry weight in the adult, 627 micrograms lipid phosphorus per gram dry weight in the larva and 242 micrograms lipid phosphorus per gram dry weight in the egg.

In contrast to organisms in other phyla the predominant phospholipids contain serine and ethanolamine in all stages examined, while choline phospholipids contribute from two per cent of the total in the egg to 11 per cent in the adult. The distribution and relative size of the principal phospholipid peaks separated is approximately the same in all stages of the organism examined, although differences are apparent in the minor constituents.

Consideration of the average phospholipid content of individuals of the stages examined reveals that over 99 per cent of the phospholipids of the larvae are synthesized after emergence from the egg and that the metabolic needs of the larva for serine, ethanolamine and choline for this synthesis could not be met by the reserves of the egg.

The hydrolysis of the phospholipid components phosphorylcholine and phosphorylethanolamine is shown to occur by the action of relatively non-specific alkaline phosphomonoesterases in both third instar larvae and adults. Assays of this enzyme activity showed it to decrease from larva to adult and to change in distribution from being predominantly mitochondrial in the larva to predominantly in the supernatant fraction in the adult. Evidence is presented to support the hypothesis that the phosphatase activity of the supernatant and that of the mitochondria is due to two different enzymes or enzyme complexes.

Phosphorylcholine is shown to be a naturally occurring compound in <u>Phormia regina</u> larvae and consequently a normal substrate for the phosphatases.

Nutritional studies of phospholipid components and compounds related to them were carried out under aseptic conditions using the defined diet of McGinnis et al. and a further modification of this diet.

Carnitine (vitamin B_T), O-acetyl carnitine and 2,2-

dimethylaminoethanol were shown to be adequate replacements for choline in the diet of <u>Phormia regina</u>, an organism which, in the absence of these compounds, shows a choline requirement for growth when reared on a defined diet under sterile conditions. 7-Butyrobetaine which previously had been shown to be a specific inhibitor of carnitine is shown in <u>Phormia regina</u> to be adequate substitute for either choline or carnitine in the diet.

DL-Carnitine was shown to be approximately equivalent to choline in the diet on a molar basis and is slightly more effective than 7-butyrobetaine.

The choline inhibitor 2-amino-2-methyl-propanol-1 is shown to be effective in Phormia regina, and its effects can be reversed by those compounds which replace choline in the diet as well as by choline itself. The order of effectiveness is choline > 2,2-dimethylaminoethanol $> \gamma$ -butyrobetaine > carnitine.

Formate although apparently not utilized for the biosynthesis of methyl groups for choline synthesis is shown to be metabolized to carbon dioxide by both intact growing larvae and larval homogenates.

The biosynthesis of choline from ethanolamine is shown either not to occur or to be unimportant in <u>Phormia regina</u>. Microfilm \$2.50; Xerox \$5.60. 112 pages.

A BIOCHEMICAL STUDY OF THE NATURE OF DISEASE RESISTANCE IN PLANTS

(L. C. Card No. Mic 59-6262)

Joseph Kuc, Ph.D. Purdue University, 1955

Major Professor: Professor F. W. Quackenbush

In this investigation, a biochemical approach has been employed to ascertain reasons for the resistance and immunity of plants to disease. Efforts have centered around a study of the resistance of corn to a leaf spot incited by Helminthosporium carbonium. This organism has a very limited host range, and only a few inbred lines of corn are susceptible; resistance is otherwise common throughout the plant kingdom. In an effort to uncover the mechanism for resistance in corn, the immunity from attack of potatoes and other non-host tissues was studied. Corn seedlings were difficult to inoculate with fungi and culture under laboratory conditions; however, potato tuber tissue was readily available and easily inoculated and cultured. It was hoped that the mechanism for immunity in nonhosts would be similar to the mechanism for resistance in corn the natural host.

Substances inhibitory to the growth of Helminthosporium carbonum, Ceratostomella ulmi, and Fusarium oxysporum f. lycopersici were found in the peel of Idaho-grown potatoes. The inhibitory substances were not present in potato pulp tissue; however, inhibitors were produced in the pulp tissue following inoculation with these fungi. Potato pulp, frozen or autoclaved prior to inoculation, did not produce inhibitors.

Paper chromatography and absorption spectra in the ultra-violet were used to identify phenolic compounds present in potato extracts. Chlorogenic and caffeic acid were found present in high concentration in the extracts of

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pulp inoculated with H. carbenum and then incubated for 72 hours. Pulp tissue held for 72 hours contained a low concentration of the acids; fresh pulp, frozen pulp, or autoclaved pulp inoculated with H. carbonum and then incubated, had little or none of the acids.

Pure caffeic acid was found to inhibit the growth of H. carbonum at a concentration of 1×10^{-3} M, and completely stopped growth at 1×10^{-2} M. Chlorogenic acid was approximately one half as active. Media containing caffeic and chlorogenic acid, obtained from potato peel or pulp tissue inoculated with H. carbonum and then incubated, were found to inhibit the growth of H. carbonum. Analyses of inhibitory potato extracts indicate the presence of chlorogenic and caffeic acid at a concentration sufficiently high to account for part of the inhibition observed. Other compounds present in potato extracts appear to increase the activity of chlorogenic and caffeic acid. These compounds themselves are not inhibitory. Cysteine was found to possess this synergistic activity.

Potatoes appear to possess a passive and active mechanism for immunity from attack by the fungi studied. Inhibitory substances are present in peel tissue, the first barrier to infection; however, if the peel is injured or removed, adjacent pulp tissue is capable of producing inhibitory substances around the points of infection. The immunity of potatoes from attack by the fungi studied may depend on the presence of chlorogenic and caffeic acid in peel tissue, and on the ability of tissue beneath the peel to pro-

duce these acids as a response to infection.

The above information was applied to the study of resistance in corn. It appears that resistant corn tissue produces a substance inhibitory to the growth of H. carbonum as a response to penetration by the fungus, and susceptible tissue produces a lower concentration of inhibitor. Resistant and susceptible tissue contain little or none of the inhibitor prior to inoculation with H. carbonum. The inhibitor appears to be localized immediately around the points of fungus penetration, and is not translocated to any appreciable extent. Unlike potatoes, resistant corn appears to exhibit only an active resistance to attack by

Sclerotium rolfsii and Fusarium solani, fungi which parasitize potatoes, were found capable of stimulating potato pulp tissue to produce compounds inhibitory to the growth of H. carbonum. These compounds and compounds in potato peel did not inhibit growth of the potato pathogens. The resistance of potatoes to attack by the fungi studied, therefore, does not appear to depend upon the biochemical response of the host, but does depend on the sensitivity of the fungus' metabolism to the products produced by the

host.

The mechanism for inhibition of H. carbonum by caffeic and chlorogenic acid is not known; however, it appears to be associated with the polyphenoloxidase in the fungus. It appears that this oxidase is essential to the fungus for growth, respiration and normal pigmentation. Growth inhibition of the fungus, induced by naturally-occurring phenolic compounds or specific inhibitors of polyphenoloxidase, is accompanied by the production of red pigment instead of the normal black-green. It is possible that naturally-occurring phenolic compounds are associated with disease resistance, and that these compounds function by inhibiting the polyphenoloxidase complex in the fungus.

A great deal of work must still be done before we can achieve an understanding of the biochemical mechanism in plants and fungi determining disease resistance. The work described merely suggests promising avenues for future research. Microfilm \$2.50; Xerox \$4.40. 83 pages.

THE AMINO ACID REQUIREMENTS FOR MAINTENANCE IN THE ADULT ROOSTER

(L. C. Card No. Mic 60-1439)

Gilbert A. Leveille, Ph.D. Rutgers University, 1960

Major Professor: Hans Fisher

The initial studies were concerned with the determination of the minimal nitrogen and energy requirements for the maintenance of nitrogen equilibrium in the adult nonprotein depleted rooster. Whole egg protein and a free amino acid mixture in which 13 of the amino acids were supplied at the same level as found in whole egg protein served as nitrogen sources.

The nitrogen requirement in the non-depleted bird was found to be 280 mg N/kg body weight/day with either whole egg protein or free amino acids as the nitrogen source. In the protein depleted animal the nitrogen requirement was half of that of the non-depleted animal or 140 mg N/kg/day from either whole egg protein or free amino acids.

The metabolizable energy requirement at a nitrogen intake of 280 mg N/kg/day was not greater than 90 Cal./kg/day with whole egg protein as the nitrogen source. When free amino acids served as the nitrogen source the caloric requirement was increased by at least 20 Cal. of metabolizable energy/kg/day.

The adult rooster reached the endogenous level of nitrogen excretion after three days on a nitrogen free diet. The average endogenous nitrogen excretion was 143 mg

N/kg/day.

The amino acid diet simulating whole egg protein (supplying 280 mg N/kg/day) was used as the complete starting diet. The level of one amino acid at a time was reduced in a step-wise fashion. Glycine and glutamic acid replaced the amino acid lowered isonitrogenously. Daily nitrogen balances were determined during the last three days of the 5 or 6 day feeding period employed for each

The least squares line, resulting when nitrogen balance or nitrogen excretion (where nitrogen intake was constant) was plotted against the mg of amino acid supplied/kg body weight, was used to calculate the maintenance requirement and the minimum maintenance level. The maintenance requirement in these studies was taken as the lowest level of an amino acid which would maintain the same degree of nitrogen balance as observed with the complete starting diet: the minimum maintenance level was taken as the lowest level of an amino acid which would maintain nitrogen balance.

The calculated maintenance requirement and minimum maintenance level for the amino acids essential for the adult rooster were as follows: (mg of amino acid/kg/day L-arginine 120, 54; L-lysine 29, 0; L-leucine 124, 54; L-isoleucine 72, 49; DL-valine 61, 55; L-threonine 74, 55; DL-methionine 90, 39; L-phenylalanine 60, 38;

L-tryptophan 19, 7. A maintenance requirement and a minimum maintenance level was determined for cystine in the presence of 21 mg/kg/day of DL-methionine and for L-tyrosine in the presence of 26 mg/kg/day of L-phenylalanine. These requirements were estimated to be 42 and 38 mg/kg/day for L-cystine and 31 and 22 mg/kg/day for L-tyrosine respectively. In the presence of adequate cystine the maintenance requirement and minimum maintenance level of methionine were reduced by 21 and 62% respectively. Tyrosine was found to replace phenylalanine by 55% at the maintenance requirement and 66% of the minimum maintenance level.

Histidine was found to be non-essential for the maintenance of nitrogen balance in the adult non-protein depleted rooster.

Data presented show that the adult rooster is capable of utilizing D-valine and D-methionine completely but that the D-isomers of threonine and isoleucine are not utilized.

The minimum maintenance level determined for the essential amino acids, cystine and tyrosine showed a high degree of correlation to the amino acid composition of feather protein (r = +0.86). The validity and nature of this relationship is discussed.

Microfilm \$2.50; Xerox \$6.40. 132 pages.

SOME EFFECTS OF DIET ON THE CONCENTRATION OF BLOOD AND LIVER PYRIDINE NUCLEOTIDES

(L. C. Card No. Mic 60-1499)

Mary Alice Morrison, Ph.D. The University of Wisconsin, 1960

Supervisors: Professors Alfred E. Harper and May S. Reynolds

These investigations were undertaken to study the utilization in rats of niacin and tryptophan when graded levels of each were fed in the diet. The utilization of tryptophan in protein synthesis was evaluated from the weight gains of the animals on different diets, and the utilization of niacin and tryptophan as precursors of pyridine nucleotides in tissues was measured in both blood and liver. It was of particular interest to see to what extent pyridine nucleotide concentrations in blood would reflect the adequacy of intake of niacin and tryptophan, since blood components can be readily measured in human subjects. In these studies, an amino imbalance diet, prepared by adding either gelatin or DL-threonine to a diet containing 8% of casein was used. In these diets tryptophan was low, and nicotinic acid was omitted, and the animals on the diet exhibited signs of niacin deficiency.

Liver pyridine nucleotide concentrations of weanling rats maintained for two weeks or 10 weeks on the diets were not depressed when either 6% of gelatin or 0.36% of DL-threonine, both of which caused a growth retardation, were added. There was no loss of ability to synthesize liver pyridine nucleotides in the animals maintained on these imbalance diets for 10 weeks.

Growth depressions caused by the addition of gelatin or threonine were prevented by nicotinic acid, but pyridine nucleotides in the liver were unchanged. Tryptophan also prevented the growth depression, but in this case a large increase occurred in the pyridine nucleotide concentration in the livers of the animals fed the diet with threonine, although only a slight increase was obtained in livers of animals on diets with gelatin.

Liver pyridine nucleotide concentrations did not decline either when a more severe imbalance, which could not be prevented by nicotinic acid alone, but which required tryptophan, was produced by the addition of 12% of gelatin to the basal diet. The diet used in the next part of the study was similar except that 6% of casein was used, in order to reduce the per cent of tryptophan in the diet.

Weanling rats fed the diet containing 6% of casein and 12% of gelatin exhibited a growth response to increments of L-tryptophan in the diet up to 0.06% of the diet. Blood and liver pyridine nucleotide concentrations increased with increasing increments of tryptophan in the diet.

The sparing effect of nicotinic acid on tryptophan was indicated from the results obtained with diets in which tryptophan was present at sub-optimal levels. When the diets contained 2.5 mg % nicotinic acid, the growth rate was higher than when no tryptophan was added, and the growth response was most marked with 0.02% of additional tryptophan instead of 0.06%. Increments of nicotinic acid up to 250 mg % were no more effective than the 2.5 mg % in stimulating growth.

Nicotinic acid (2.5 mg %) causes a substantial increase in blood pyridine nucleotide concentration, which is not related to the adequacy of the diet as evidenced by gain in weight. Liver pyridine nucleotide concentrations were also increased. Excess quantities of both nicotinic acid and tryptophan in the diet increase both liver and blood pyridine nucleotide concentrations, but have no additional effect on growth.

The specificity of threonine in producing the imbalance was studied also. It was found that an imbalance of amino acids could be produced in diets containing 8% of casein and L-cystine or DL-methionine by the addition of 0.36% DL-threonine. This imbalance caused a depression in the growth rate of rats which could be corrected with either nicotinic acid or tryptophan. In the present studies, of a variety of amino acids tested only threonine was effective in causing a growth depression. Phenylalanine, previously found to have a growth depressing action was not effective, nor were leucine, lysine, valine, isoleucine, glutamic acid or arginine unless they were in combination with threonine.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

THE EFFECT OF HYPERTHYROIDISM ON VITAMIN A REQUIREMENT IN THE RAT

(L. C. Card No. Mic 59-6272)

Roberta Ellen Nelson, Ph.D. Purdue University, 1958

Major Professor: S. M. Hauge

It has been postulated that hyperthyroidism increases an animal's requirements for vitamin A. However, the evidence presented in the literature is conflicting. Therefore, the purpose of this investigation was to study the effect of hyperthyroidism on vitamin A metabolism by determining the daily requirement and liver storage of vitamin A in the hyperthyroid rat.

Weanling albino rats (equal numbers of males and females) were depleted of vitamin A stores on vitamin A deficient diets. Graded levels of vitamin A were then administered to these animals for an experimental period of four weeks. Hyperthyroidism was induced by including iodinated casein in the diets during the experimental period. The growth responses of the normal and hyperthyroid rats were then used to determine the vitamin A requirements. The method used to calculate vitamin requirements determines the lowest level of vitamin which allows the maximum growth inherently possible in all individuals. In order to determine the effect of hyperthyroidism on liver storage of vitamin A, vitamin A deficient rats were given 100 International Units of vitamin A for four weeks. Graded levels of iodinated casein were incorporated into the diets during this time. The livers were then analyzed for vitamin A content.

The vitamin A requirement of normal rats maintained on a basal diet composed of all the known essential nutrients was found to be 27 International Units per day. It was not possible to determine accurately the vitamin A requirement of hyperthyroid rats maintained on this basal diet. The growth attained by these animals was limited by a deficiency of accessory factors. A supplement of one per cent liver only partially corrected the deficiencies of the basal diet. Five per cent distiller's dried solubles, however, provided the accessory factors required by the hyperthyroid rat.

When the accessory factors were included in the diet, the vitamin A requirement of normal rats was found to be approximately 15 International Units per day. The requirement of hyperthyroid rats also was approximately 15 International Units of vitamin A per day. The amount of vitamin A required was not related to the degree of hyperthyroidism within the ranges studied. Rats receiving 0.01 per cent iodinated casein required about the same amount of vitamin A as rats receiving 0.05 per cent iodinated casein.

The effect of a liver concentrate or distiller's dried solubles on the vitamin A requirements of normal and hyperthyroid rats cannot be attributed to the vitamin A activity of these supplements. The results suggest that these supplements may contain a factor or factors which are beneficial to the growth of both normal and hyperthyroid rats.

Normal rats and rats receiving 0.025, 0.050 and 0.100 per cent iodinated casein stored approximately the same amounts of vitamin A per gram of liver. Addition of a liver concentrate or distiller's dried solubles to the diet did not influence the storage of vitamin A in the livers of normal or hyperthyroid rats.

Microfilm \$2.50; Xerox \$3.00. 48 pages.

VITAMIN D AND CITRATE OXIDATION

(L. C. Card No. Mic 60-1504)

Sheldon Reiser, Ph.D. The University of Wisconsin, 1960

Supervisor: Assistant Professor Hector F. DeLuca

The finding that vitamin D additions to rachitogenic and non-rachitogenic rations reduced the oxidation of citrate by rat kidney homogenates led to an investigation of the mechanism by which this reduction occurred. Although the physiological significance of this effect is not as yet understood, it is possible that it results from the fundamental action of vitamin D.

The effect of vitamin D was found to reside in the mitochondrial fraction and was found to be specific for citrate and isocitrate since little or no effect was observed with glutamate, succinate, α -ketoglutarate, β -hydroxybutyrate and pyruvate plus oxalacetate as substrates. There was also no effect of the vitamin on the phosphorylations associated with these oxidations nor was there an effect on citrate oxidation by liver mitochondria. It was furthermore possible to demonstrate a reduction in citrate and isocitrate oxidation by the addition of either vitamin D_2 or D_3 in vitro to kidney mitochondria from rachitic rats. This decreased oxidation was specific for the vitamin since neither their provitamins nor structurally similar compounds were effective.

Despite the marked decrease in citrate oxidation in intact mitochondria, no effect of dietary vitamin D was found on the activities of the known enzymes involved in citrate oxidation, i.e., DPN and TPN isocitric dehydrogenases, aconitase, transhydrogenase, DPNH and TPNH cytochrome c reductases. In harmony with these findings, it was also demonstrated that vitamin D had no effect on the oxidation of citrate generated within the mitochondria by the oxidation of pyruvate plus oxalacetate while it decreased the oxidation of externally added citrate in these same preparations.

The addition of mitochondrial swelling agents, viz. cysteine, cholate, and small amounts of malate or succinate to the reaction medium resulted in a marked stimulation of citrate oxidation and virtual elimination of the effect of vitamin D. In a similar fashion, conditions adverse to the maintenance of mitochondrial structure, such as low ATP concentration in the reaction medium and lowered osmolar sucrose concentration both in the reaction and isolation media, increased citrate oxidation and decreased the vitamin D effect. Conversely, conditions favoring the preservation of mitochondrial structure, such as increased ATP concentration in the reaction media and increased osmolar sucrose concentrations in both isolation and reaction media, lowered citrate oxidation and increased the effect of vitamin D. In other experiments, it was also found that decreased concentrations of phosphate, increased amounts of substrate and additions of pyridine nucleotides increased greatly citrate oxidation and greatly diminished the vitamin D effect.

The preparation of mitochondria in 0.001 M EDTA - 0.25 M sucrose medium resulted in a specific inhibition of citrate and isocitrate oxidation. Citrate oxidation by these preparations was insensitive to changes in ATP or phosphate concentration but was greatly stimulated by additions of pyridine nucleotides and small quantities of malate or

succinate. Nevertheless, the effect of vitamin D was still evident in the EDTA prepared particles.

In studies with the electron microscope, it was found that vitamin D had a striking effect on the structure of isolated kidney mitochondria. The mitochondria from vitamin D deficient animals were larger, showed extensive damage of internal structure, and a greater tendency to fragment; while the mitochondria from the vitamin D supplemented rats showed none of these tendencies. When prepared in 0.44 M sucrose, the kidney mitochondria from vitamin D supplemented rats compared very favorably in structural integrity to those observed in intact tissue. It was further noted that under conditions of active metabolism, vitamin D greatly aided in preserving mitochondrial size and structure. The preparation of mitochondria from vitamin D deficient rats in an 0.001 M EDTA - 0.25 M sucrose medium resulted in much more intact preparations than those prepared from 0.25 M sucrose alone. Mitochondria from vitamin D supplemented rats prepared in 0.25 M sucrose showed no significant difference in structure when EDTA was added to the isolation medium.

The results strongly suggest that vitamin D preserves the structural integrity of isolated rat kidney mitochondria, thereby limiting the penetration of citrate into the mitochondria, and thus reducing its oxidation rate.

Microfilm \$2.50; Xerox \$5.60. 113 pages.

TOXICITY AND METABOLISM OF BETA-AMINOPROPIONITRILE AND RELATED COMPOUNDS IN CHICKS, TURKEYS AND RATS.

(L. C. Card No. Mic 60-1505)

Dwijendra Nath Roy, Ph.D. The University of Wisconsin, 1960

Supervisors: Professors H. R. Bird and F. M. Strong

Beta-aminopropionitrile (BAPN) is the toxic principle found in sweet peas (Lathyrus odoratus), which produces the symptoms of osteolathyrism. Attempts were made to find some substance which could attenuate the toxic symptoms produced by BAPN. Various amino acids, and other chemicals were supplemented at different levels in a practical diet containing corn, soybean oil meal etc., and fed to chicks and turkey poults along with BAPN fumarate, but no beneficial effect was observed. BAPN fumarate at a level of 0.036% of the diet produced leg deformities, and aortic rupture. L-proline at levels from 0.5 to 2.0% had no effect on the leg deformities and aortic rupture in chicks, but did result in increased growth, either in the presence or absence of BAPN fumarate.

Cyanoacetic acid (CAA) is one of the metabolites of BAPN found in rat urine and turkey excreta. It was found to be non-toxic to turkey poults, even when fed at very high levels. The conversion of BAPN to CAA is presumed to occur under the active influence of monoamine oxidase (MO). Two known inhibitors of MO, isonicotinic acid hydrazide and 1-isonicotinyl-2-isopropyl hydrazine at 0.04 to 0.08% of the diet were non-toxic, but when fed together with BAPN fumarate (0.02%), the toxic symptoms due to BAPN were greatly enhanced.

Since it was suspected that there might be some toxic

factor other than the BAPN-containing compound, beta-(N-gamma-L-glutamyl)-aminopropionitrile, in sweet peas, feeding experiments were conducted with extracted and unextracted sweet peas at high levels. Sweet peas were extracted with 30% ethyl alcohol to remove all BAPN containing substances and the residue was dried and fed at very high levels to turkey poults. Unextracted sweet peas at a 40% level were toxic, and the intensity of toxicity was comparable to that of 0.098% BAPN fumarate. Unextracted sweet peas at levels of 33 and 25% caused almost the same toxic symptoms in turkey poults. Extracted sweet peas at the level of 33% did not produce any toxic symptoms, only poor growth was observed. Thirty-three percent field peas did not produce any toxic symptoms. Beta-(Ngamma-L-glutamyl)-aminopropionitrile at a level of 0.087% of the diet did not cause any specific toxic symptoms except that 10% mortality due to internal hemorrhage was observed.

Turkey poults were used in attempts to find other lathyrogens. Semicarbazide HCl at 0.06% of the diet was lethal, while 0.015% produced only a depression in growth rate, but no marked leg or toe deformities. Toxic symptoms were increased with increasing levels of semicarbazide·HCl; at a level of 0.03% of the diet it caused death due to internal hemorrhage. Mercaptoethylamine-HCl at 0.4% of the diet was very toxic. The toxicity was increased with the increasing level of the compound. No internal hemorrhage was observed by mercaptoethylamine-HCl feeding. Nitrofurazone and furazolidone at levels of 0.12 and 0.24% were very toxic. Mortality increased with increasing level, and no internal hemorrhage was observed. Phenylhydrazine was very toxic, but no lathyrogenic symptoms were observed. 4-aminomethyl pyridine at 0.045% was non-toxic. No beneficial effect was found when pyridoxine hydrochloride was added to a diet containing semicarbazide HCl.

The lathyrogenic activity of 2-cyanopropylamine (CPA), a methyl homolog of BAPN, was studied in chicks, turkeys, and weanling rats. Dissecting aneurism of the aorta resulted in all these species. Although characteristic deformities of the leg bones appeared in chicks and turkeys, lathyritic osseous changes were not produced in rats. A level of 0.216% CPA in the diet of turkey poults was at least as toxic as 0.043% free BAPN. In the urine of rats unchanged CPA and 2-cyanopropionic acid were found.

Microfilm \$2.50; Xerox \$5.80. 118 pages.

BIOSYNTHESIS OF POLYENE ANTIBIOTICS, WITH PARTICULAR REFERENCE TO THE ROLE OF MEVALONIC ACID IN THE PRODUCTION OF ANTIMYCOIN.

(L. C. Card No. Mic 60-1449)

Robert Samuel Safferman, Ph.D. Rutgers University, 1960

A Streptomyces aureus culture, strain 3569, that had been found to produce the tetraene antibiotic, antimycoin, ceased production of the antifungal agent. Paper chromatographic studies of remaining antimycoin preparations demonstrated two antifungal components. The faster moving component had been named antimycoin A. A bacterial

factor obtained from an air contaminant that was later identified as a Micrococcus sp., strain 140, induced S. aureus strain $3\overline{5}69$ (R-19) to synthesize antimycoin A in solid media. The inducing agent was isolated as a colorless, crystalline material and found to be mevalonic acid $(\beta, \delta$ -dihydroxy- β -methylvaleric acid).

Other compounds related to mevalonic acid were examined in the induced antimycoin system. Of the many compounds tested, only mevaldic acid showed activity.

Antimycoin A can also be produced by S. aureus in shake-flask cultures if high concentrations of calcium and magnesium chlorides are added to the media. The addition of 30 mg/liter of mevalonic acid as a dibenzylethylenediamine salt to the salt-rich media both increased and accelerated the production of antimycoin A.

Of nine other polyene-producing actinomycetes tested in a medium supplemented with mevalonic acid (in the form of the dibenzylethylenediamine salt), two organisms exhibited marked increases in antibiotic synthesis. They included S. viridoflavus, strain 3685, and Streptomyces sp., strain 3832, the producers respectively of candidin and a pentaene of the eurocidin group (antibiotic S-8). In addition, data have been presented concerning isotopic studies on the role of mevalonic acid in the biosynthesis of antimycoin A.

Antimycoin A in aqueous solution was bound rapidly to cells of Saccharomyces cerevisiae. Upon washing the cells free of excess polyene after 24 hours of incubation, it was found that less than 1% of the cells had survived. When sterols of the cholesterol, ergosterol, and stigmasterol groups were incubated in the aforementioned polyene inhibitory system, they prevented the antifungal action of antimycoin A on the yeast. Spectrophotometric, as well as manometric and biological, assays demonstrated a physicochemical effect between antimycoin A and these particular sterols. In no case was there evidence of a metabolic interrelationship.

Microfilm \$2.50; Xerox \$7.00. 148 pages.

LYSINE VASOPRESSIN, AN HYPOTHALAMIC MEDIATOR OF ACTH RELEASE IN THE GUINEA PIG.

(L. C. Card No. Mic 60-1315)

Martin Bernard Sideman, Ph.D. University of Southern California, 1960

Chairman: Professor Sobel

The classical experiments of Green and Harris and Bargmann and Scharrer initiated the present concept of hypothalamic mediation of ACTH release. It is generally believed that following stress a peptide which originates in the hypothalamous reaches the anterior pituitary gland via the hypothalamic-hypophyseal portal vasculature and causes increased secretion of ACTH. It is further believed that this peptide is normally stored in the posterior pituitary gland, after its transmission from the hypothalamus via the interconnecting nerve tracts.

Attempts to isolate and identify this substance have led to two schools of thought concerning the nature of this peptide. One school believes that vasopressin is the active ACTH releasing factor, while the other believes that it is another substance, similar in structure.

Experiments were performed on a posterior pituitary extract (pitressin) to determine the nature of the substance(s) contained therein which causes increased excretion of urinary corticoids in the guinea pig. Intraperitoneal injections of one pressor unit per one hundred grams of body weight caused reproducible doubling of excreted corticoids. Treatment of pitressin by iodination, diazomethane, and placental extracts could not separate the ACTH releasing activity from the pressor activity. Destruction of both activities by iodination and placental extracts was of equal magnitude.

Pitressin powder was subjected to paper electrophoresis at pH 5.7. The fraction which moved the fastest in the direction of the cathode contained all of the ACTH releasing activity and nearly all of the pressor activity of the crude powder.

The active fraction, upon hydrolysis in constant boiling HCl, was shown to contain only the amino acids present in lysine vasopressin when it was analyzed on a two-dimensional paper chromatogram.

Mild hydrolysis, at pH 1.2 and pH 11.55, of this active fraction induced a proportionate loss of ACTH releasing and pressor activities with increase in time. A constant value was obtained when the ratio of the urinary corticoid producing activity (\triangle C) and the pressor activity (\triangle P) was determined as hydrolysis proceeded.

Group	ΔC	$\Delta \mathbf{P}$	$\frac{\Delta C}{\Delta P}$
Hydrolysis pH 1.2			
0 minutes	64	38	1.7
10 minutes	59	32	1.5
20 minutes	40	26	1.5
30 minutes	35	23	1.5
40 minutes	15	-	_
Hydrolysis pH 11.55			
0 minutes	60	21	2.9
5 minutes	58	20	2.9
10 minutes	41	14	2.9
20 minutes	18.	7	2.6

While the above experiments were in progress, Schally, Saffran, and Zimmermann isolated a decapeptide with ACTH releasing activity but without pressor activity. This substance remains active after treatment with 2.2 N HCl at 110° C. for ninety minutes. In order to explain the difference in reactivity of lysine vasopressin and the material of Schally et al. to acid hydrolysis, and amino acid composition, the following structure is proposed for the latter: histidine is present in place of tyrosine in the ring portion of the vasopressin molecule, and alanine and serine in a peptide bond replace an amide, particularly the one on the glycine moiety. This replacement of an amide bond by a peptide bond could well account for the stability to mild acid hydrolysis.

It is suggested that four moieties of the molecule of lysine vasopressin are necessary for ACTH releasing activity. Three of these groups are also necessary for pressor activity. The groups are (1) -S-S- bond in cystine, (2) an unaltered phenolic group in tyrosine, (3) an amide bond on glycine, and (4) the presence of lysine in the molecule. Alterations in any of the first three moieties result

in loss of both activities. Lysine may be replaced by arginine without loss of pressor activity, but this molecule will not have appreciable ACTH releasing activity.

Microfilm \$2.50; Xerox \$5.80. 117 pages.

THE PURIFICATION AND CHARACTERIZATION OF MAMMALIAN CYTOCHROME C1

(L. C. Card No. Mic 60-1454)

Herbert Warren Staub, Ph.D. Rutgers University, 1960

Major Professor: Dr. Walter W. Wainio

A partial purification of mammalian cytochrome \underline{c}_1 was effected from a beef heart muscle insoluble preparation. The deoxycholate extraction technique was refined, and when combined with ammonium sulfate precipitation yielded a relatively pure preparation. Cytochrome \underline{c} was initially removed from the heart muscle preparation by washing with phosphate buffer and at a later stage an additional amount was removed by adsorption on Amberlite IRC 50 resin. The lability of cytochrome \underline{b} during storage and its ready sedimentation in the ultracentrifuge are properties that were used in the preparation. The purified preparation has absorption peaks at 417-418 m μ , 523 m μ , and 552-553 m μ in the reduced state.

Further purification of preparations from which the deoxycholate was removed by adsorption on an ion exchange resin was unsuccessful. The methods used included iso-octane extraction, treatment with lipases, and freezing and thawing. The initial treatment of the preparation with the ion exchange resin caused considerable denaturation and may have prevented the subsequent methods from being effective.

The purified cytochrome c_1 can be reduced by DPNH or succinate in the presence of a small quantity of diluted beef heart muscle insoluble preparation. It can also be reduced by DPNH alone. Reduction by DPNH is not inhibited by antimycin A or SN 5949.

The major enzyme contaminant is a persistent diaphorase activity. The purified preparation, however, cannot link the oxidation of DPNH by Straub's diaphorase to the reduction of cytochrome \underline{c} . The presence of lipoic acid, the quinone Q_{275} , or heart lipid, individually or in combination, has no effect.

The anaerobic reduction of fumarate to succinate when linked to the oxidation of DPNH to DPN in the presence of an insoluble heart muscle preparation can be accelerated by cytochrome \underline{c}_1 . When the heart muscle preparation is treated with antimycin A the reaction can no longer be accelerated by cytochrome \underline{c}_1 . Cytochrome \underline{c}_1 cannot reactivate the DPNH oxidase of an antimycin A-treated insoluble heart muscle preparation. Cytochrome \underline{c}_1 slowly reduces cytochrome oxidase anaerobically and the addition of cytochrome c accelerates the reaction.

Microfilm \$2.50; Xerox \$7.60. 164 pages.

THE EFFECT OF ANTIBIOTICS ON THE METABOLISM OF NORMAL AND HYPERTHYROID RATS

(L. C. Card No. Mic 59-6274)

George Raymond Vogel, Ph.D Purdue University, 1958

Major Professor: S. M. Hauge

It is now well established that the growth rate of young animals is usually increased by adding relatively small amounts of certain antibiotics to the ration. This growth response usually takes place with a greater feed utilization. The exact role of antibiotics as a factor in growth has been a perplexing problem in recent years but, nevertheless, a subject of considerable interest. The objective of this study was to investigate the possibility that antibiotics may modify the stimulation effect of the thyroid hormone in increasing the vitamin requirements of albino rats.

The general scheme decided upon in an attempt to solve this fundamental problem involved three major areas of investigation: (1) measurement of basal metabolism by a series of oxygen-consumption studies, (2) determination of the requirement of a particular vitamin with and without the antibiotic and at various levels of hyperthyroidism, and (3) analysis of the blood for the thyroid hormone as indicated by protein-bound iodine.

In preliminary experiments it was found that the oral administration of penicillin (40 mg/100 g ration) had no significant effect on the oxygen-consumption of control animals or those fed the antibiotic in rations containing 25 mg or 50 mg of thyroprotein per 100 g. However, the antibiotics did counteract the retardation of growth due to thyroprotein.

The oxygen consumption of normal and hyperthyroid albino rats was measured before and after the intramuscular injection of 1.2 mg (0.2 ml of solution) of procaine penicillin G, Aureomycin, or Ilotycin. The final measurements were observed at either one or three hour intervals after the injection. The antibiotics caused a statistically significant decrease in the rate of oxygen consumption in both normal and hyperthyroid rats. This effect diminished with time and was reasonably constant at the various levels of thyroidally active casein (thyroprotein) in the ration. Similar effects were observed with procaine penicillin G after oral administration (1.5 mg/100 g of body weight) by stomach tube.

A series of experiments were conducted to determine the effect of dietary procaine penicillin G and thyroprotein on the thiamin requirements, growth at high levels of essential nutrients, and feed efficiency of albino rats. The animals were fed graded levels of thyroprotein (0, 0.01, 0.03, and 0.05%) and thiamin (5, 10, 15, 25, and 30 μg daily/rat) with and without procaine penicillin G (0.02%). The effect of thyroprotein on these factors was overcome in all cases by the addition of the antibiotic to the diet. Penicillin decreased the thiamin requirements and increased growth at high vitamin levels as well as feed efficiency. These effects were directly proportional to the level of thyroprotein in the ration and was a direct, linear relationship in the case of growth increments induced by penicillin and thyroprotein in high vitamin levels. Only a slight influence of penicillin was observed with rats on a basal ration.

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The protein-bound iodine level of rat serum was determined after various antibiotic treatments in order to detect any influence on blood thyroidal activity. The particular treatments involved intramuscular injection (1.2 mg/100 g body weight) of penicillin or physiological saline solution (0.2 ml/100 g body weight) and oral administration of penicillin (1.5 or 3.0 mg/100 g body weight) by stomach tube. Although a slight decrease after each treatment was observed, the statistical analysis revealed that such values were not significant. Similar results were obtained when a high level of penicillin (0.05%) was fed to rats as a part of the thyroprotein (0.03%) ration.

It is suggested that some type of antagonism exists between thyroidal activity and certain antibiotics. Since the studies revealed a definite decrease in oxygen consumption by rats after antibiotic treatment, the antibiotic apparently alters the metabolism of the animal but in some manner independent of the blood level of the thyroid hormone. Further studies are needed to clarify the exact mode of action.

Microfilm \$2.50; Xerox \$4.20. 76 pages.

A STUDY OF THE CHEMICAL COMPONENTS OF THE EGG SHELL OF DROSOPHILA MELANOGASTER

(L. C. Card No. Mic 60-1457)

Billy Ray Wilson, Ph.D. Rutgers University, 1960

Major Professor: Dr. Andrew J. Forgash

Paper chromatography of the hydrolysate of Drosophila melanogaster egg shell shows the presence of 14 amino acids in appreciable quantities, plus traces of one or two others. Aspartic acid and alanine are the most abundant. Serine, glutamic acid, glycine, and tyrosine occur in equal amounts, however, these amino acids are present in smaller amounts than aspartic acid and alanine. Lysine and arginine are found in equal amounts, but these are less abundant than the preceding amino acids. Threonine and valine were present in the lowest quantities of any amino acids which were determined quantitatively. Although it was not possible to make quantitative measurements, it was noted that proline, hydroxy-proline, leucine and/or isoleucine, and histidine occur in substantial amounts. Cystine and/or cysteine occur as traces. The nitrogen content of the shell averages 13 percent, which indicates a protein content of 80 to 82 percent.

Glucosamine constitutes at least 0.6 percent of the Drosophila egg shell. Spectrographic analysis shows the presence of 14 elements, 13 of which are metals. Calcium is most abundant, followed by aluminum, copper, magnesium, and silicon. Iron, manganese, sodium, and phosphorus come next, while silver, chromium, nickel, lead, and titanium are present in small amounts or occur as traces.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

EFFECT OF X-RAYS ON NUCLEIC ACID ISOLATED FROM TOBACCO MOSAIC VIRUS

(L. C. Card No. Mic 60-1343)

John Andrew Wohlhieter, Ph.D. University of Pittsburgh, 1959

In order to elucidate the nature of the action of x-rays on tobacco mosaic virus (TMV), the effect of x-rays on ribonucleic acid (RNA) isolated from TMV has been investigated.

It had previously been shown that RNA isolated from irradiated virus was less viscous than that isolated from unirradiated virus. With the ultraviolet optics of the ultracentrifuge the sedimentation distribution of an RNA solution can be observed. RNA isolated by the Schramm phenol technique from a predominantly homogeneous preparation of TMV contains a homogeneous component of corresponding size. It is possible to follow quantitatively the reduction of this homogeneous component of RNA isolated from irradiated virus. These effects of x-rays, reduction of viscosity and reduction of the amount of material in the homogeneous component, have been interpreted as indicating breakage of the RNA strand.

In the present study the RNA was isolated before irradiation to eliminate the effect of the extraction procedure on irradiated RNA. When dilute RNA solutions were frozen and irradiated, the rate of breakage was somewhat slower than that of RNA extracted from irradiated TMV. The dose which reduces the amount of the original homogeneous material to 37 per cent of the original is called D_o for breakage. For dilute solutions this dose was about 7×10^5 r. Either increasing concentration of the irradiated solution or removing oxygen raised the D_o for breakage to about 19×10^5 r. Combination of these two treatments increased the D_o for breakage to about 24×10^5 r. Thus, conditions which are standardly used to eliminate the indirect action of radiation reduce the breakage of RNA.

One of the possible products of indirect action resulting from irradiation of water that could cause breakage of RNA is hydrogen peroxide. The hydrogen peroxide treatment of RNA caused a small amount of breakage but not enough to account for the breakage observed when RNA is irradiated. Drying is known to eliminate the indirect action; however, drying RNA did not reduce the rate of breakage. These data indicate that RNA breakage is not caused by indirect action. Consequently, the effect of oxygen may, as others have suggested, be to develop breakage of radiation-weakened sites.

Although in the absence of oxygen the RNA was protected from breakage, some modification must have occurred because mild heat or phenol treatment, which had no effect on unirradiated RNA, increased the breakage of irradiated RNA. The total breakage never exceeded breakage of RNA in the intact virus where the protein coat would prevent indirect radiation action. It seems reasonable to conclude that the lethal action of radiation on RNA in TMV is a direct one, and that, it is observable as breakage primarily as a result of subsequent phenol extraction.

RNA isolated by the phenol technique from TMV retains some of the infectivity of the original virus. The biological inactivation of the RNA was found to proceed much faster than breakage; the D_o for the inactivation was found to be 1×10^5 r. Microfilm \$2.50; Xerox \$3.00. 50 pages.

BIOPHYSICAL AND BIOCHEMICAL STUDIES OF YEAST RIBOSOME AND ITS PROTEIN MOEITY

(L. C. Card No. Mic 60-1583)

Fay Hoh Yin, Ph.D. The University of Wisconsin, 1960

Supervisor: Associate Professor Robert M. Bock

The ribosomes of yeast may be obtained as a component which sediments as a single peak in the ultracentrifuge. The sedimentation and diffusion coefficients $(S_{20}, w = 82 \times 10^{-13} \text{ sec}^{-1}, D_{20}, w = 1.4 \times 10^{-7} \text{cm}^2 \text{sec}^{-1})$ gave a molecular weight of 4.6 million $(\bar{v} = 0.67)$. The data from sedimentation, diffusion, low angle x-ray scattering and electron microscopy are best fitted by a porous spherical model with 1.33 grams of water of hydration per gram of ribosome. The composition of the ribosome is 43% RNA, and 57% protein.

Base, acid, urea, 67% glacial acetic, low and high salts, detergents, thioglycollate and formamide failed to give a stable solution of the ribosomal protein. It was found that, after removal of the RNA with ribonuclease, a simultaneous treatment with 8 molar urea and 0.2% Na dodecyl sulfate gave a solution which remained stable even after removal

of the urea and detergent by dialysis.

Velocity and equilibrium ultracentrifugation showed that the ribosomal protein is heterogeneous with an average molecular weight of 12,000. Eight different amino acids were found as amino terminal groups. If this protein molecule is a structural unit of the ribosome, then 230 of the 12,000 molecular weight sub-units could occur in each 82 S ribosome. Microfilm \$2.50; Xerox \$4.20. 76 pages.

CHEMISTRY, INORGANIC

ACID AND BASE PROPERTIES OF SOME GROUP IV ORGANOHYDROXY COMPOUNDS

(L. C. Card No. Mic 60-1483)

Ronald Howard Baney, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Robert West

The acidity and basicity of several organo-hydroxy compounds of the group IV elements have been investigated both by infrared spectroscopic study of their hydrogen bonding properties and by potentiometric titration in a non-aqueous system. The most important theoretical conclusions from these studies are the following:

1. Extensive dative pi-bonding takes place between oxygen and silicon in silanols, probably involving a single unshared electron pair on oxygen and a single d orbital on silicon. 2. Resonance and inductive effects are transmitted through the silicon-oxygen bond much as they are through the carbon-oxygen bond, indicating that dative pi bonding between silicon and oxygen does not alter the

transmission of normal electronic effects. 3. The amount of $d\pi$ -p π bonding between the metal and oxygen decreases going from silicon to germanium to tin and lead.

The acidity of some carbinols and analogous silanols as proton donors in hydrogen bonding was determined by measuring the shift in frequency of the OH stretching band upon admixture with the Lewis Bases, ether, mesitylene and benzene in dilute carbon tetrachloride solution. The silanols were found to be much more acidic than carbinols with analogous structure. Similarly the hydrogen bond basicity employing phenol as the hydrogen bonding acid has been determined for the silanols and carbinols. The silanols were found to be only slightly weaker bases than the carbinols. Intermolecular hydrogen bonding association of some silanols and analogous carbinols was also studied by infrared spectroscopy. Both the strength and extent of self association were found to be greater for the silanols than for the corresponding carbinols.

The enhanced acidity of silanols, contrary to that predicted from the normal inductive effects of silicon, is explained in terms of a model involving pi bonding of a porbital on oxygen into an unoccupied dorbital on silicon. The availability of the remaining porbital on oxygen for hydrogen bond formation was used to explain the observed

basicity.

The transmission of resonance and inductive effects in substituted arylsilanols through the silicon oxygen bond was studied by measuring the acidity of these compounds. Hydrogen bond acidities similar to those mentioned above as well as Brönsted acidities determined by a potentiometric titration in a pyridine solution were used to determine the relative acidities. The relative acid strengths were then compared to those predicted from normal electronic effects of the substituent groups as measured by Hammett sigma constants. Electronic effects of the substituent groups were found to influence acidities in a normal fashion. In the course of these studies five new silanols were prepared.

Stepwise replacement of methyl groups for phenyl groups in triphenylsilanol were found to decrease both the hydrogen bond acidity and the Brönsted acidity by a constant amount. This was interpreted to mean that phenyl groups are not extensively pi bonded to silicon

in silanols.

The acidity and basicity as hydrogen bond donors and acceptors has been measured for the compound $(C_8H_5)_8$ MOH where M=C, Si, Ge, Sn, Pb. The order of increasing acidity was found to be Sn, Pb, < C, Ge << Si. The order of increasing basicities was found to be C, Si < Ge << Sn, Pb. Intensity measurements of OH stretching bands on the compounds were found to support the order of acidities. The trends in acidity and basicity were interpreted to mean that the amount of dative pi bonding between the metal and oxygen decreases with increasing size of the metal, from silicon to lead, with carbon exhibiting no pi bonding. This interpretation is contrary to accepted theories of $d\pi$ -p π bonding.

For compounds of the type (C₆H₅)₃ MOH and other organohydroxy compounds, a linear relationship was found between the OH stretching frequency and the electronegativity of the atom to which the hydroxyl group is attached. This relation was found to hold as long as there is not significant dative pi bonding between the atom and oxygen.

Microfilm \$2.50; Xerox \$8.60. 189 pages.

KINETICS OF THE FERRICYANIDE-FERROCYANIDE EXCHANGE REACTION IN TETRAPHENYLARSONIUM HYDROXIDE SOLUTIONS

(L. C. Card No. Mic 60-1399)

Perry King, Jr., Ph.D. Washington University, 1960

Chairman: Arthur C. Wahl

Solutions of $Fe(CN)_6^{-3}$ and $Fe*(CN)_6^{-4}$ (tagged with $Fe^{5.5}$ $Fe^{5.9}$) were mixed and allowed to react for a measured time interval. The reaction was quenched by the extraction of $Fe(CN)_6^{-3}$ into a solution of \emptyset_4 AsCl in CHCl₃ with $Ru(CN)_6^{-4}$ and $Co(CN)_6^{-3}$ present to retard heterogeneous exchange during the extraction. The specific activity of the $Fe(CN)_6^{-3}$ fraction was determined. The rate of electron exchange was calculated from a series of determinations with different reaction times. The mixing of the reactants and the quenching of the reaction were controlled electronically to provide reproducible conditions.

The following results were found when the composition of the reactant solutions and the temperature were varied. The reaction is first order in $Fe(CN)_6^{-3}$, but the dependence of the rate on $Fe(CN)_6^{-4}$ concentration is not simple. The rate of exchange is very dependent on the nature and concentration of the cation present. An observable increase in rate occurs when the reactant solutions are $7 \times 10^{-4} \text{ M}$ in K^+ , or $1 \times 10^{-5} \text{ M}$ in Ca^{++} or Ba^{++} . The reaction is first order in both $Fe(CN)_6^{-3}$ and $Fe(CN)_6^{-4}$ when ethylenediaminetetraacetic acid is added to complex cationic impurities. No large specific anion effects were observed. The reaction is first order in \emptyset_4 As $^+$, but essentially independent of the ionic strength at constant \emptyset_4 As $^+$ concentration. The rate data are consistent with the rate law

Rate =
$$k(Fe(CN)_6^{-3})(Fe(CN)_6^{-4})(\emptyset_4 As^+)$$
.

The experimental activation energy is 6.1 ± 0.3 kcal. mole⁻¹ in 0.01 M \varnothing_4 As⁺, 6.3 ± 0.3 kcal. mole⁻¹ in 0.02 M \varnothing_4 As⁺, and 7.2 ± 0.3 in 0.04 M \varnothing_4 As⁺.

The specific cation effect can be explained most simply by assuming that exchange occurs between Fe(CN)₆⁻³ and species of Fe(CN)₆⁻⁴ formed by association with cations. However, qualitative conclusions based on calculations by Scatchard of activity-coefficient effects are also consistent with the rate data.

Microfilm \$2.50; Xerox \$4.20. 79 pages.

THE GEOCHEMISTRY OF THE STABLE ISOTOPES OF CHLORINE

(L. C. Card No. Mic 60-1322)

Patrick LeGrand Parker, Ph.D. University of Arkansas, 1960

Major Professor: Thomas C. Hoering

A study of the elemental and isotopic abundances of chlorine found in a variety of natural materials has been made. The materials used include various igneous rocks, stone meteorites, sea water, oil brines and several evap-

orite deposits. The chlorine content of the rocks analyzed agreed with the amount found by other workers. The average chlorine content of ten stone meteorites was 0.022 percent. It was found that the C1-37/C1-35 ratio is constant to within plus or minus one per mil. A few variations in the chlorine isotope ratio of less than one per mil were observed.

The fact that chlorine from sea water has the same isotopic composition as chlorine from igneous rocks and stone meteorites to within one per mil is explained in terms of an outgassing of the mantle of the earth of the compound ammonium chloride.

$$NH_4Cl_{(g)} = NH_{3(g)} + HCl_{(g)}$$

The isotope effect brought about by this reaction would not fractionate the chlorine isotopes more than one per mil. Therefore, it is proposed that the large excess of chlorine in sea water is due to the outgassing of the mantle of ammonium chloride.

The equilibrium isotope effect was measured for several exchange reactions involving chlorine in order to test the chemistry and mass spectroscopy used.

Microfilm \$2.50; Xerox \$5.00. 97 pages.

NEUTRON ACTIVATION CROSS-SECTIONS WITH 14.8 MEV NEUTRONS IN THE REGION OF THE 28-PROTON CLOSED SHELL AND (n,He³) REACTIONS WITH MEDIUM WEIGHT NUCLEI

(L. C. Card No. Mic 60-1323)

Ivor Louis Preiss, Ph.D. University of Arkansas, 1960

Major Professor: R. W. Fink

Neutron activation cross-sections for the isotopes of nickel, zinc, Co⁵⁹ and Cu⁶⁵ were measured for 14.8 ± 0.9 Mev neutrons from the T(D,n)He⁴ reaction at 400 Kev with the University of Arkansas Cockcroft-Walton positive ion accelerator. Cross-section measurements were also made for the (n,He³) reaction at 14.8 Mev for the isotopes Mn⁵⁵, Al²⁷, p³¹, V⁵¹, Co⁵⁹, Cu⁶⁵, As⁷⁵ and Rh¹⁰³.

In the case of the nickel isotopes, particular attention was paid to measurements of (n,np) cross-sections, and examinations of the integral decrease in the (n,p) values with increasing atomic number as predicted by Levkovskii.

The products of the various neutron induced reactions were identified by half-life, gamma-ray spectra, and chemical behavior. Cross-section calculations are discussed with regard to the errors encountered, flux monitors, and general techniques used in these measurements.

In general, the cross-sections were based on the gross beta decay curves found using $2-\tau$ end-window and window-less gas-flow proportional counters. In the cases of the $\operatorname{Co^{58g}}$, $\operatorname{Ni^{57}}$, and $\operatorname{Co^{60m}}$ isotopes produced via the $\operatorname{Ni^{58}}$ (n,p) and $\operatorname{Co^{59}}$ (n,2n), $\operatorname{Ni^{58}}$ (n,2n) and $\operatorname{Ni^{60}}$ (n,p), and $\operatorname{Ni^{61}}$ (n,np) reactions, respectively, the total disintegration rate was found by integrating a specific gamma-ray peak. The gamma-ray spectra were found by using a $1 \times 1-1/2$ inch $\operatorname{NaI}(\operatorname{Tl})$ crystal with a single channel pulse height analyzer and a manual scaler.

Chemical separation techniques were employed in

identifying the products of Co⁵ (n,p), (n,2n), and (n,He³) reactions and in measuring the cross-sections of Ni⁵ 8. In making the mass assignments of the products obtained from neutron irradiation of copper foils, two different chemical separation methods were used. The chemical yields of these separation procedures were determined by employing radioactive tracers under identical conditions to those encountered with irradiated samples.

The cross-sections obtained for (n,p), (n,2n), (n,α) , and (n,np) reactions were compared to the cross-sections predicted by the continuum model of the compound nucleus developed by Blatt and Weisskopf. This comparison of experimental and theoretical cross-sections showed that, in general, the reactions leading to multi-particle emission (i.e., (n,np) and (n,α) reactions) were much more probable than the theory predicted. In addition, the (n,p) experimental cross-sections found for Co59 and the nickel isotopes were smaller than the compound nucleus prediction, while these same experimental cross-sections for copper and zinc isotopes were larger than anticipated. A qualitative explanation of this anomalous behavior is presented based on the direct interaction of the incident neutron with individual nucleons and nucleon-clusters existing in the target nucleus. In considering these direct interactions processes, the effect of the 28 proton closed shell has been taken into account.

Support for the incident neutron-nucleon cluster mechanism was also found in considering the magnitude of the (n,He³) reactions.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

THE ALKALINE EARTH COMPLEXES OF 2,6-PYRIDINEDICARBOXYLIC ACID AND THEIR ANION EXCHANGE PROPERTIES

(L. C. Card No. Mic 60-1577)

Dean Oliver Skovlin, Ph.D. State University of Iowa, 1960

Chairman: Professor William E. Bennett

The acid dissociation constants of 2,6-pyridinedicarboxylic acid were determined by the pH method. The values of these constants at 25.0° C and an ionic strength of 0.10 are: pK₁ = 2.24 and pK₂ = 4.67.

The stability constants of the chelates formed between magnesium, calcium, strontium and barium and the anion of the above acid were also measured by the same method. The values of the 1:1 ($\log K_{ma}$) and the 2:1 ($\log K_{ma_2}$) constants at 25.0°C and an ionic strength of 0.10 are as follows:

Metal	log K _{ma}	log K _{ma2}
Mg	2.32	disconnectal - se
Ca	4.60	2.56
Sr	3.80	1.73
Ba	3.43	on If allowing the last of

The low value of $\log K_{ma}$ for magnesium has been ascribed to a combination of two effects; the planar structure

of the ligand and the higher heat of hydration of the magnesium ion.

The anion exchange coefficients have been determined for the exchange, between an aqueous and resin phase, of the above metal chelates. The resin, Dowex I, was in the form of the above ligand.

It was found that at a ligand concentration of 0.80 x 10⁻¹ molar, the order of adsorption by the resin was magnesium > strontium > barium > calcium. The order of adsorption at a ligand concentration of 1.00 x 10⁻³ molar was calcium~strontium >> barium > magnesium. This change in the order of adsorption has been related to the values of the stability constants of the chelates formed by the above metals and the ligand anion.

The calculation of the amounts of the complex species present in the solution at equilibrium for the four complex systems has revealed that the shape of the distribution curves is directly related to the fraction of the metal in solution that exists as the neutral species. When the fraction of the metal as the neutral species is at maximum in the outer solution, the distribution curve is also at a maximum.

It is proposed, for the system studied in this paper, that the slope of the distribution curve at a given ligand concentration is directly related to the average number of moles of bound ligand and is given by $(1-\bar{n})$. The experimental slopes agree quite well with those calculated from the calculated values of \bar{n} using the above equation.

Elution experiments were performed in order to demonstrate possible separations of the alkaline earth metal from each other with this ligand system. It was shown that this ligand system does not afford a simple one step elution separation of all four of the metals studied. However it was shown that either magnesium or barium can be separated from calcium and strontium. Other separations, i. e. calcium from strontium or magnesium from barium, should be possible using a column longer than the one used in this work at an eluant ligand concentration of about 0.10 molar.

Microfilm \$2.50; Xerox \$6.00. 124 pages.

NEUTRON ACTIVATION CROSS-SECTIONS WITH 14.8 MEV NEUTRONS IN THE REGION OF THE 82-NEUTRON CLOSED SHELL

(L. C. Card No. Mic 60-1325)

Raymond George Wille, Ph.D. The University of Arkansas, 1960

Major Professor: R. W. Fink

Activation cross-sections on 27 stable nuclides of elements barium, lanthanum, cerium, praseodymium, neodymium, samarium, europium, gadolinium, dysprosium, erbium, ytterbium, and lutetium were measured for 14.8 ± 0.8 Mev neutrons from the T(d,n)He⁴ reaction with total fluxes of 10¹⁰ to 10¹¹ neutrons/second from the University of Arkansas 400 Kv Cockcroft-Walton accelerator. Elements barium through samarium each have an isotope with an 82-neutron closed shell. The method involves irradiation of a sample containing the isotope whose cross-section is to be studied with 14.8 Mev neutrons; after

irradiation, the sample was chemically separated (when necessary), the chemical yields determined, the radioactive products counted and identified specifically by their known half-lives, and the cross-sections for the particular reaction determined.

Measured cross-sections for (n,2n) reactions were found to agree within an order of magnitude with statistical evaporation theory; the experimental values for the (n,p) and (n,α) cross-sections, however, generally are larger than those calculated from the statistical evaporation theory on the compound nucleus model. The deviation between theoretical cross-sections (based on the compound nucleus model) and the observed cross-sections, generally is attributed to a competing direct interaction mechanism; several current direct interaction models are discussed in relation to the present study.

During the course of this investigation several previously unreported activities were observed. The probable mass assignments are as follows: 12 ± 3 min Pr¹⁴⁸, 0.5 ± 0.1 min Sm¹⁵⁷, 7 ± 1 min Tb¹⁶³, 3.3 ± 0.5 min Ho¹⁶⁸, 40 ± 10 sec Ho¹⁷⁰, 4.4 ± 0.4 min Dy¹⁶⁷.

Microfilm \$2.50; Xerox \$5.80. 119 pages.

CHEMISTRY, ORGANIC

I. A STUDY OF THE CHEMISTRY OF 2-BENZAL-4,4-DIMETHYL-1-TETRALONE OXIDE AND ITS DERIVATIVES. II. THE TRANSMISSION OF CONJUGATIVE EFFECTS IN ARYL-AROYL THREE-RING COMPOUNDS.

(L. C. Card No. Mic 60-1529)

Ronald E. Bambury, Ph.D. The University of Nebraska, 1960

Adviser: Dr. N. H. Cromwell

The purpose of the investigation was to study the chemistry of 2-benzal-4,4-dimethyl-1-tetralone oxide and its derivatives and also to study the transmission of conjugative effects in aryl-aroyl three-ring compounds.

The synthesis of 2-benzal-4,4-dimethyl-1-tetralone was extended to include compounds with p-methoxy, p-methyl and p-dimethylamino groups substituted in the benzal-phenyl ring. The oxides of these compounds were prepared and 2-benzal-4,4-dimethyl-(m-chlorobenzal)-1-tetralone oxide was also prepared.

The boron trifluoride rearrangement of 2-benzal-4,4-dimethyl-1-tetralone oxide (XVIII) was found to give 6-phenyl-9,9-dimethylbenzocycloheptane-5, 7-dione which could be isolated in an enol or a diketo form. The addition of methylmagnesium bromide to XVIII was shown to give 1-hydroxy-2-benzal-1,4,4-trimethyltetralin oxide (IX) which when reduced with lithium aluminum hydride gave 1,2-dihydroxy-2-benzal-1,4,4-trimethyltetralin (XIV). Lithium aluminum hydride was shown to reduce XVIII to give 1,2-dihydroxy-2-benzyl-4,4-dimethyltetralin (X), while sodium borohydride with XVIII gave 1-hydroxy-2-benzal-4,4-dimethyltetralin oxide (XI), which could be

converted to X by reduction with lithium aluminum hydride. Hydrogenation of XVIII with a platinum catalyst gave XI and also some $2-(\alpha-hydroxybenzyl)-4,4-dimethyl-1-$ tetralone. This latter compound and a small amount of X were produced when XVIII was hydrogenated with a palladium catalyst.

Treatment of 2-(p-nitrobenzal)-4,4-dimethyl-1-tet one oxide with dry hydrogen chloride yielded a chlorhydrin that was assigned the structure 2-chloro-2-(α -hydroxy-p-nitrobenzoyl)-4,4-dimethyl-1-tetralone on the basis of its infrared spectrum.

A good method was found for reducing 2-hydroxy-2-(α -chlorobenzyl)-4,4-dimethyl-1-tetralone to 2-hydroxy-2-benzyl-4,4-dimethyl-1-tetralone (XIII). The structure of the latter was verified by hydrogenating it to give compound X. Treating XIII with acid in the presence of acetic anhydride caused it to dehydrate and rearrange to yield 2-benzyl-3,4-dimethyl-1-naphthol acetate. When XIII was treated with methyl magnesium bromide it gave XIV. The structure of 2-hydroxy-2-(α -methoxybenzyl)-4,4-dimethyl-1-tetralone was proved by converting it to 1,2-dihydroxy-2-(α -methoxybenzyl)-4,4-dimethyl-tetralin.

A mixture of <u>cis-</u> and <u>trans-1-cyclohexyl-2-(p-meth-oxyphenyl)-1-3-benzoylethylenimine was prepared by treating a mixture of cyclohexylamine and anisalaceto-phenone with iodine. The isomers were separated by fractional crystallization and the structures assigned from spectral evidence.</u>

Phenylhydrazine was condensed with 2-benzoyl-1-tetralone to give a pyrazole which was not the same as the pyrazole produced when 2-benzal-1-tetralone oxide is treated with phenylhydrazine. The fact that the pyrazoles were not the same allowed tentative structure assignments to be made on the basis of the expected course of the reaction.

The splitting of the carbonyl band observed in the infrared spectrum of several α -epoxyesters, α -epoxyketones, α -aminoketones and ethylenimine ketones was ascribed to dipole interactions and hyperconjugative effects.

An examination of the ultraviolet and infrared spectra of some aryl-aroylethylenimine ketones and some aryl-aroyl-ethylene oxides showed that transmission of the conjugative effect of a p-methoxy group in the aryl nucleus is not transmitted through the three-ring to the aroyl group.

The infrared and ultraviolet spectra of all the compounds prepared were correlated with the structures of the compounds.

Microfilm \$2.50; Xerox \$5.20. 101 pages.

I. THE ENERGY DIFFERENCE BETWEEN THE CHAIR AND THE BOAT CONFORMATIONS
 OF CYCLOHEXANE.
 II. THE SYNTHESIS AND FAVORSKII
 REARRANGEMENT OF ALICYCLIC
 α-FLUOROKETONES.

(L. C. Card No. Mic 60-1484)

Victor John Bauer, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor William S. Johnson

I. The Energy Difference Between the Chair and the Boat Conformations of Cyclohexane.

Although physical measurements have clearly substantiated that the chair conformation of cyclohexane is energetically more favorable than the boat form, no measurement, other than approximate theoretical treatments, of the magnitude of the stability difference has been reported. We have developed the first experimental determination of this quantity [W. S. Johnson, J. L. Margrave, V. J. Bauer, M. A. Frisch, L. H. Dreger, and W. Hubbard, J. Am. Chem. Soc., 82, (1960), in press].

The addition of diethyl sodiomalonate to $trans-\Delta^2$ octalin epoxide afforded, after saponification and decarboxylation, 3a-hydroxy-trans-decalin-2a-acetic acid (I)
(the symbol a indicates an axial substituent; e denotes an
equatorial orientation). Mild chromic acid oxidation to 3keto-trans-decalin-2a-acetic acid was followed by akaline
epimerization of the axial acetic acid moiety to yield the
isomeric 3-keto-trans-decalin-2e-acetic acid. A stereoselective reduction, utilizing sodium in alcohol, then pro-

duced the diequatorially substituted 3e-hydroxy-trans-decalin-2e-acetic acid (II). Cyclization of II afforded the lactone III, in which the chair conformation of the center ring was retained. Lactonization of I yielded, only under more vigorous reaction conditions, the isomeric product IV, in which the center ring was constrained in the boat conformation.

The remaining possible isomeric hydroxyacids and lactones were prepared, and a second pair of similar chair-boat isomers was synthesized.

Heat of combustion determinations on highly purified samples of III and IV indicated, after correction to the gas phase by addition of the experimentally measured heats of sublimation, that the chair containing compound was more stable than the boat isomer by 5.3 ± 0.3 kcal./mole.

The magnitude of the stability difference has been

employed in an argument proving that the flexible conformation of cyclohexane (of which the boat is an extreme example) may be more accurately described as a median modification named the twist form (V) [W. S. Johnson, J. Am. Chem. Soc., 82, (1960), in press].

II. The Synthesis and Favorskii Rearrangement of Alicyclic α -Fluoroketones.

The preparation of α -fluoroketones by the reaction between active methylene compounds and perchloryl fluoride was investigated. 1-(1-cyclohexenyl) pyrrolidine or 2-ethoxalylcyclohexanone yielded 2-fluorocyclohexanone, 2-carbethoxy-trans-1-decalone afforded 2-fluoro-2-carbethoxy-trans-1-decalone, and 1-methoxyl-trans- Δ 1-octaling gave 2-fluoro-trans-1-decalone when treated with perchloryl fluoride. The orientation of the fluorine atom in 2-fluorocyclohexanone was shown to be equatorial.

2-Fluorocyclohexanone underwent the Favorskii rearrangement in low yield. It appeared that the α -fluoroketones were inferior to their chloro and bromo analogues in this reaction.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

SYNTHESIS AND PROPERTIES OF THE ETHYL 2- AND 4-PYRIDYLPYRUVATE ESTERS

(L. C. Card No. Mic 59-6959)

Michael M. Besso, Ph.D. Lehigh University, 1959

The primary objective of this work was the synthesis of the ethyl 2- and 4-pyridylpyruvate esters and a study of their tautomeric behaviour and chemical reactivity.

Ethyl 2-pyridylpyruvate was prepared in 10% yield by the reaction of 2-picolylcadmium chloride with diethyl oxalate in ether solution at -70°C. for five minutes. This reaction failed when applied to the 4-isomer. Ethyl 4-pyridylpyruvate was prepared in 10% yield by the reaction of di-4-picolylmercury with diethyl oxalate in ether solution at -70°C. The yields of product were not improved despite several variations in the reaction conditions.

Ethyl 2-pyridylpyruvate is a fluorescent yellow crystalline solid with a melting point of 82.5-83.5°C. The enol content was determined by the Kurt Meyer technique to be 98%. After standing for 3 days at 25°C., the enol content of a methanolic solution decreased to 92.5%. Although this ester is undeniably an enolic compound, it did not react with diazomethane. In addition, there was no infrared absorption at 2.8-3 microns which would be expected for a compound containing an N-H or O-H group.

The continued absence of the usual N-H or O-H absorption, even upon dilution, is indicative of intramolecular association. All of these facts suggest that ethyl 2-pyridyl-pyruvate exists as a chelated enol structure. Further evidence was obtained by the observation that the addition of hydrochloric acid to an ethanol solution had a very slight effect on the ultraviolet absorption spectrum. The absorption maximum displayed a hypsochromic shift in solvent systems of increasing polarity.

Ethyl 4-pyridylpyruvate is a yellow-orange powder with a melting point of 138-139°. The enol content of the solid

ester was found to be 92%. The enol content of a methanol solution decreased to 52% in ten minutes and subsequently to 33.5% after 3 days. As in the case of the 2-isomer, there was no reaction with ethereal diazomethane. Molecular weight determination indicated an associated structure. The infrared spectrum showed no absorption maximum at 2.8-3.0 microns, however, a strong, broad band appeared from 3.3-3.8 microns. The spectrum in chloroform showed two sharp peaks, one at 2.75 and the other at 3.35 microns. Thus, it appeared that the intermolecular associated structure of the solid ester was disrupted by the solvent and resulted in the appearance of the O-H or N-H peak and the C-H peak at their expected wave lengths.

A number of derivatives of both compounds were prepared. The phenylhydrazones underwent the Fischer indole ring closure and after hydrolysis and decarboxylation yielded 3-(2-)pyridylindole and 3-(4-)pyridylindole. The absorption spectra of these compounds were determined.

Microfilm \$2.50; Xerox \$5.20. 102 pages.

I. THE FORMATION OF CYCLOPROPANES FROM PHOSPHORANES AND EPOXIDES.

II. THE MECHANISMS OF THE REACTIONS OF EPISULFIDES AND EPOXIDES WITH TRISUBSTITUTED PHOSPHINES.

(L. C. Card No. Mic 60-1425)

Marvin Jay Boskin, Ph.D. Rutgers University, 1960

Major Professor: Dr. Donald B. Denney

PART I.

A new synthesis of cyclopropane compounds was accomplished by allowing epoxides to react with the phosphorane, $Ph_3P = CH-COOC_2H_5$. The epoxides used were styrene oxide which gave ethyl trans-2-phenylcyclopropanecarboxylate and octene-1-oxide which gave ethyl 2-hexylcyclopropanecarboxylate. In both cases, triphenyl-phosphine oxide was also produced.

This phosphorane was also allowed to react with cyclohexene oxide in an attempt to prepare ethyl 7-norcaranecarboxylate. Neither this compound nor triphenylphosphine oxide was found. Only the starting material was isolated.

PART II.

The reaction of episulfides with trisubstituted phosphorus compounds or phenyl lithium has been shown to give an olefin and R₃ PS or PhS⁻ Li⁺. In order to determine the mechanism of this reaction, the isomeric 2-butene episulfides were prepared and allowed to react with triphenylphosphine, tributylphosphine and phenyl lithium. The trans episulfide gave only trans-2-butene and the cis episulfide gave only cis-2-butene. The rates of the reactions of the isomeric episulfides with triphenylphosphine were measured and shown to be relatively unaffected by changes in the dielectric constant of the solvent. These experiments indicate that the desulfurization of episulfides by these nucleophiles occurs via attack on sulfur with simultaneous cleavage of both carbon-sulfur bonds. This

concerted mechanism, allows little or no charge separation in the transition state which is consistent with the kinetic results. A kinetic study on 1-butene episulfide showed that this compound reacts with triphenylphosphine by the same mechanism.

The deoxygenation of epoxides was accomplished with tributylphosphine in a sealed tube at 150°. Trans-2-butene epoxide yielded 72% cis-2-butene and 28% trans-2-butene while cis-2-butene epoxide yielded 81% trans-2-butene and 19% cis-2-butene. The major component in these mixtures can be accounted for by a mechanism involving attack on carbon to give a zwitterion which then, by internal rotation, forms a four-membered ring containing phosphorus. Decomposition of this intermediate yields the olefin and the phosphine oxide.

In order to determine whether the minor olefin component arises by attack on oxygen, in a manner similar to that found for the reaction with episulfides, tributylphosphine was allowed to react with $\Delta^{9,10}$ -octalin epoxide under the same conditions as was used for the butene epoxides. Since no $\Delta^{9,10}$ -octalin was isolated, it was concluded that the minor component was not produced by attack of the nucleophile on the oxygen atom. Several modes of formation of the minor component are suggested and discussed. Microfilm \$2.50; Xerox \$3.60. 62 pages.

NITRATION STUDIES. THE EFFECTS OF CHLORINE IN NITRATIONS OF ALKANES AND ALKENES.

(L. C. Card No. Mic 59-6263)

John Paul Chupp, Ph.D. Purdue University, 1956

Major Professor: G. Bryant Bachman

This investigation was concerned with the various effects of chlorine, used in combination with either nitric acid or nitrogen dioxide to promote the vapor phase nitration of hydrocarbons leading to nitro compounds. Chlorine was used in conjunction with nitrogen dioxide in studies of the nitration of alkanes and alkenes, while chlorine in combination with nitric acid was studied in the vapor phase nitration of cyclohexane. These studies are compared with those of previous workers in the field.

Chlorine greatly increases the rate of nitration of propane and n-butane with nitrogen dioxide. Uncatalyzed nitration with nitrogen dioxide requires 14 minutes for 27% conversion, while oxygen-promoted nitration requires contact times of 2 minutes for the same conversion. Chlorine-promoted nitration requires only 2 seconds at 350°, employing a C₃H₈/NO₂/Cl₂ ratio of 11/1/0.4 for a 26% conversion. Therefore, chlorine-promoted nitration with nitrogen dioxide may now be carried out at contact times comparable to those employed in vapor phase nitration with nitric acid. The faster rate in the presence of added chlorine over uncatalyzed nitration with nitrogen dioxide has been ascribed to the ability of chlorine to rapidly create the reactive species (alkyl radicals), which in combination with NO₂ radicals lead to nitroparaffins.

Conversions of nitrogen dioxide to nitroparaffin remains low (26%), and are not increased with increasing

chlorine concentration, as was found to be the case in nitration with nitric acid. Yields of nitroparaffin based on nitrating agent are comparable however with the corresponding yields obtained in nitrations with nitric acid, because correspondingly more nitric oxide is recovered in nitrations with nitrogen dioxide. Yield and conversion data suggest that catalysts can not raise conversions appreciably in nitrogen dioxide nitrations because of the ready reduction of nitrogen dioxide induced by the catalyst.

Chlorine-promoted nitrations with nitrogen dioxide yield products in which the nitro derivatives of the undegraded hydrocarbon predominate; an observation identical to that found in chlorine-promoted nitration with nitric acid.

Apparently, chlorine is effective in catalyzing the nitration of higher hydrocarbons with nitric acid as it is in propane nitration. Conversions are increased from 25% in uncatalyzed nitration to 37% when chlorine is present at a C₆H₁₂/HNO₃/Cl₂ ratio of 17/1/0.2 at 423°. It was found that there is an optimum in conversion at about Cl₂/HNO₃ of 0.2, conversion. Oxygen in combination with chlorine does not increase conversions appreciably, unlike the effect of these combinations on conversion in nitration of propane. This difference is explained by the inability of oxygen to furnish simple alkyl radicals from reaction with cyclohexane. High concentrations of cyclohexane also increase conversions in both chlorine-promoted and uncatalyzed nitration.

The nitration of olefins in the vapor phase at elevated temperatures gives predominately oxidation products when nitric acid is the nitrating agent. The reaction between propylene and nitrogen dioxide in the vapor phase gives heavy, viscous, nitrogen containing oils, unstable to heat, apparently arising from complex addition of nitrogen oxides to the olefin with concurrent and subsequent oxidation and pyrolysis reactions. The reaction of olefins with nitrogen dioxide is simplified if chlorine is added in more than catalytic amounts. Vapor phase chloronitration, a new reaction, results when chlorine and nitrogen dioxide are simultaneously added to an olefin giving rise to chloronitroparaffins. These compounds are more stable to heat, oxidation and hydrolysis than the products arising from pure addition of nitrogen oxides.

Both propene and 1-butene give beta-chloronitroalkane in 9-12% conversion based on nitrogen dioxide when reacted at the optimum temperature of 270° and 3-4 seconds contact time along with larger amounts of 1,2-dichloroalkane. The only isomer isolated in nitration of 1-alkenes is the 1-chloro-2-nitroalkane.

Microfilm \$2.50; Xerox \$7.80. 169 pages.

STUDIES OF SOME PEROXIDE REACTIONS

(L. C. Card No. Mic 60-1428)

Dorothy Ziebell Denney, Ph.D. Rutgers University, 1960

Major Professor: Donald B. Denney

I. A Study of the Role of the Potential Anion in the Rearrangement of p-Methoxy-p'-nitrobenzoyl Peroxide

<u>p</u>-Methoxy-<u>p</u>'-nitrobenzoyl peroxide, labeled with oxygen-18 in the <u>p</u>-nitrobenzoyl carbonyl, was allowed to rearrange in thionyl chloride, to give labeled <u>p</u>-methoxy-phenyl-<u>p</u>-nitrobenzoyl carbonate. Reaction with ammonia gave <u>p</u>-nitrobenzamide, containing 66% of the excess oxygen-18 present in the carbonate.

These results show that during the rearrangement of the peroxide the p-nitrobenzoate ion does not become completely free; however, some scrambling of the label does occur. The results are explained in terms of ion pairs having some covalent bonding character.

II. A Study of the Mechanism of the Cupric Chloride Catalyzed Reaction of t-Butyl Perbenzoate with Olefins

Allylbenzene reacted with t-butyl perbenzoate in the presence of catalytic amounts of cupric chloride to yield 1-phenylallyl benzoate; propenylbenzene, under the same conditions, gave cinnamyl benzoate. Thus, no common intermediate is formed from these two olefins.

The deuterium isotope effect (k_H/k_D) for this reaction was determined by allowing 3-phenyl-3-deuterio-1-propene to react with t-butyl perbenzoate in the presence of cupric chloride. The isotope effect found was 4.3 at 90°. The magnitude of this isotope effect is not what would be expected for the reaction of a t-butoxy radical with allylbenzene; such a reaction should have a smaller isotope effect.

These results are discussed and incorporated into a proposed mechanism.

III. Studies of the Mechanisms of the Reactions of Benzoyl Peroxide with Secondary Amines and Phenols

Benzoyl peroxide, labeled with oxygen-18 in the carbonyl positions, reacted with dibenzylamine to afford Obenzoyl-N,N-dibenzylhydroxylamine containing all of the excess oxygen-18 originally incorporated in one carbonyl oxygen of the peroxide. Transesterification with ethanol gave dibenzylhydroxylamine, containing no excess oxygen-18 and ethyl benzoate containing essentially all of the excess oxygen-18. These results are consistent with a mechanism involving displacement by the amine on a peroxide oxygen to give, ultimately, the hydroxylamine benzoate.

Diphenylamine reacted with benzoyl peroxide, labeled with oxygen-18 in the carbonyl positions, to yield N-phenyl-N-o-hydroxyphenylbenzamide which contained essentially all of the oxygen-18 originally incorporated in one carbonyl oxygen of the peroxide. Basic hydrolysis afforded o-hydroxydiphenylamine containing 45% of the oxygen-18 incorporated in the amide. Thus, an assignment of the excess oxygen-18 in the amide could be made; 45% in the phenolic oxygen and 55% in the carbonyl oxygen.

It is postulated that this reaction proceeds by initial attack of the amine on a peroxide oxygen with elimination of a benzoate ion. The resulting O-benzoyl-N,N-diphenyl-hydroxylamine, having all of the oxygen-18 localized in the carbonyl, is considered to be an unstable intermediate which rearranges to o-N-phenylaminophenyl benzoate through an ion pair or pairs with almost complete equilibration of the oxygens. This substituted diphenylamine rearranges to product with no scrambling of the label.

p-Cresol reacted with benzoyl peroxide, labeled with oxygen-18 in the carbonyl positions, to yield 2-hydroxy-4-methylphenyl benzoate containing essentially all of the oxygen-18 originally incorporated in one carbonyl oxygen of the peroxide. Basic hydrolysis afforded 2-hydroxy-4-methylphenol containing 13% of the excess oxygen-18. Thus, the distribution of oxygen-18 in the ester must be 13% in the ether oxygen and 87% in the carbonyl oxygen. The facts available indicate that the reaction most likely proceeds by displacement by the phenolic hydroxyl on a peroxide oxygen to give an unstable perester which rearranges to product via ion pairs. It is suggested that all of the scrambling of the label occurs during the rearrangement of the perester.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

THE ALUMINUM HALIDE CATALYZED DIMERIZATION OF PERHALOGENATED CYCLOPENTADIENES

(L. C. Card No. Mic 59-6268)

Ralph Hervey Earle, Jr., Ph.D. Purdue University, 1957

Major Professor: E. T. McBee

I. A Structural Study of Perchloropentacyclo [5,2,1,0^{2,6},0^{3,9},0^{5,8}] decane and Related Compounds.

The reaction of hexachlorocyclopentadiene with aluminum bromide to form brominated analogues of perchloropentacyclo[5,2,1,0^{2,6},0^{3,9},0^{5,8}]decane (II) has been investigated. On the basis of the extent of bromine incorporation in the molecule during the reaction, a possible mechanism for the dimerization is advanced. Additional evidence is offered supporting the proposed structure of II and the related ketone, perchloro-pentacyclo[5,2,1,0^{2,6},0^{3,9},0^{5,8}]-decane-4-one. The preparation of the completely brominated analogue of II is also described.

II. The Halogen Exchange of Hexachlorocyclopentadiene with Aluminum Bromide.

The halogen exchange of hexachlorocyclopentadiene with aluminum bromide both with and without bromine present has been studied. The major products were 5-bromopentachlorocyclopentadiene, a dibromotetrachlorocyclopentadiene and a tetrabromotetrachlorocyclopentene. A mechanism has been advanced to explain the formation of these compounds.

III. The Aluminum Bromide Catalyzed Addition of Carbon Tetrahalides to Perhalogenated Cyclopentadienes.

The reaction of either hexachlorocyclopentadiene or hexabromocyclopentadiene with carbon tetrachloride in the presence of aluminum bromide has been found to yield 3,5-dibromo-1,2,3,5-tetrachloro-4-(dichloromethylene)-cyclopentene and an unidentified compound, m.p. 245-247°. Similarly, it was found that carbon tetrabromide adds to hexabromocyclopentadiene in the presence of aluminum bromide to form perbromo-4-(methylene)-cyclopentene.

IV. A Spectral Study of Perchloro-3,4-(bismethylene)-cyclobutene.

An unknown chlorocarbon, C₆Cl₆, m.p. 147.2-148.2°, received from Dr. H. J. Prins was investigated for a structural assignment. From a consideration of the infrared and ultraviolet spectra, it was concluded that the most reasonable structure for the compound was perchloro-3,4-(bismethylene)-cyclobutene. Further work by Prins has indicated that this structure is reasonable on the basis of the chemical evidence.

Microfilm \$2.50; Xerox \$8.20. 176 pages.

PREPARATION OF NITRO-SUBSTITUTED 1,4-DIPHENYLBUTADIENES

(L. C. Card No. Mic 60-1553)

William Elwood Franklin, Ph.D. State University of Iowa, 1960

Chairman: Professor Robert E. Buckles

A series of nine 2,5-diphenyl-2,4-pentadienoic acids, containing nitro substituents on one or both of the benzene rings, was prepared by a modified Perkin reaction. Equimolar amounts of the appropriately substituted cinnamaldehydes and phenylacetic acids were heated in excess acetic anhydride with a one molar quantity of either triethylamine or tri-n-propylamine catalyst. A comparison of the yields of these condensations showed that a meta nitro substituent of the phenylacetic acid causes an increase in yield over that of the unsubstituted phenylacetic acid, while an ortho or a para nitro substituent causes a decrease in yield. The effect of the meta nitro group is explained on the basis of its inductive effect, while the effects of the ortho and para substituents are explained as a result of the resonance delocalization of the negative charge on the intermediate enolate anion.

The Perkin reaction between the sodium salts of mand p-nitrophenylacetic acids and cinnamaldehyde in acetic anhydride were also performed. The results of these reactions, as well as an inspection of the literature, indicated that the reactions of the sodium salts in general give yields 20-40% above the corresponding reactions involving the free acids and the tertiary amine catalysts.

The modified Perkin reaction between $4-(\underline{m}$ -nitrobenzal)crotonaldehyde and \underline{m} -nitrophenylacetic acid was also performed to obtain $2,\overline{7}$ -bis $(\underline{m}$ -nitrophenyl)-2,4,6-heptatrienoic acid.

The 2,5-bis(nitrophenyl)-2,4-pentadienoic acids were then decarboxylated in quinoline over copper chromite catalyst at 220° to produce two series of 1,4-bis(nitrophenyl)-1,3-butadienes, one cis-trans and the other transtrans. These two series were separated by fractional crystallization. It is postulated that the pentadienoic acids were in the trans-cinnamic acid form and that the decarboxylation produced the cis-trans series of butadienes, some of which were partially isomerized to the transtrans forms at the high temperatures necessary for the decarboxylation to occur. It was observed that the cistrans butadienes were much more easily isomerized by heat to the trans-trans forms than were the similar cisnitrostilbenes. The cis-trans isomers were identified by their greater solubility in the usual solvents, their lower melting points, and their conversion to the more stable trans-trans forms by treatment with iodine in boiling benzene or toluene.

It was found that the ultra-violet spectra of the <u>cis</u>, <u>trans-1,4-bis</u>(nitrophenyl)butadienes had absorption maxima 2-12 m μ lower than those of the corresponding trans-trans isomers. The maximum extinction coefficients of the cis-trans butadienes were found to be only about two-thirds as large as those of the corresponding trans-trans isomers.

The infra-red spectra of both the 2,5-bis(nitrophenyl)-2,4-pentadienoic acids and the 1,4-bis(nitrophenyl)-1,3-butadienes were determined as potassium bromide pellets. The infra-red spectra of the cis-trans series of butadienes were found to have characteristic absorption frequencies at 950 cm⁻¹, 775 cm⁻¹, and 710 cm⁻¹ which were absent in the spectra of the trans-trans series of butadienes. The infra-red spectra of the pentadienoic acids all showed the 710 cm⁻¹ and 775 cm⁻¹ absorption frequencies characteristic of the cis-trans series of butadienes, thus confirming the assumption that the Perkin reaction in this case produces the trans-cinnamic acid type of product.

The 2,7-bis(m-nitrophenyl)-2,4,6-heptatrienoic acid was decarboxylated with very little isomerization to produce the 1,6-bis(m-nitrophenyl)-1-cis,3-trans,5-trans-hexatriene, which was isomerized with iodine to the all trans compound. This compound was also identified as the hexabromide derivative. The absorption spectra of the heptatrienoic acid and the hexatrienes were similar to those of the pentadienoic acids and butadienes.

Microfilm \$2.50; Xerox \$6.40. 135 pages.

STUDIES OF THE REACTIONS OF PERESTERS AND HYDROPEROXIDES WITH TRISUBSTITUTED PHOSPHINES

(L. C. Card No. Mic 60-1432)

William Frederick Goodyear, Jr., Ph.D. Rutgers University, 1960

Major Professor: Donald B. Denney

t-Butyl perbenzoate-carbonyl-O¹⁸ was allowed to react with triphenylphosphine in ether at 35° and in benzene at 60°. The t-butyl benzoate thus obtained was reduced with lithium aluminum hydride. Oxygen-18 analyses of the resulting alcohols showed that in ether the carbonyl oxygen

of the perester had retained 62% of the label and in benzene the carbonyl oxygen of the perester had retained 78% of the label. The remainder of the oxygen-18 appeared in the ether oxygen of the ester.

Other experiments demonstrated that added foreign anions are capable of modifying the course of the reaction and the products formed. It was also shown that a t-butoxide ion is, in all probability, not formed during the course of the reaction. It was found that the oxygen which ultimately becomes bonded to the phosphorus in the tertiary phosphine oxide is the oxygen originally bonded to the t-butyl group of the starting perester.

A mechanism is proposed which involves nucleophilic attack by the phosphine on the more electropositive peroxy oxygen of the perester, that is, the oxygen attached to the carbonyl carbon. The incipient negative charge on the leaving t-butoxy group is stabilized by overlap with an empty sp³d orbital on the rehybridized phosphorus atom. This leads to the formation of a pentacovalent phosphorus compound as an intermediate. It is then postulated that the intermediate is capable of ionization to an alkoxyphosphonium ion and a carboxylate ion, a process which accounts for the oxygen-18 equilibration and for the intervention of foreign anions. The decomposition of the intermediate, which is in simultaneous competition with the ionization, is proposed to proceed via an intramolecular displacement by oxygen on the tertiary carbon of the t-butyl group in a front-side attack.

Other possible mechanisms are also discussed.

The reaction was shown to follow second-order kinetics. A comparison of the reaction rates in toluene, cyclohexanone and 2-methyl-1-pentanol at 40° showed that there was little solvent effect in the reaction. This supports the contention that the transition state for the formation of the pentacovalent intermediate possesses little ionic character. From a determination of the rate constants in toluene at 40° and at 50°, the free energy (24.6 kcal./mole), enthalpy (17.9 kcal./mole) and entropy (-21.2 cal./mole-deg.) of activation were obtained.

A determination of the rates of reaction of the p-nitro p-chloro and p-benzyloxy t-butyl perbenzoates with triphenyl-phosphine showed that a Hammett sigma-rho relationship operates in the reaction. A rho value of 1.24 was obtained. A new sigma value of -0.139 was suggested for the p-benzyloxy group.

The reaction of t-alkyl hydroperoxides with trisubstituted phosphines was also investigated. Cumene hydroperoxide was allowed to react with triphenylphosphine in a methanol- $\rm H_2O^{18}$ solution. Analysis of the products, triphenylphosphine oxide and α,α -dimethylbenzylalcohol, revealed that no oxygen-18 had been acquired by either. Since no α,α -dimethylbenzyl methyl ether was found when the reduction was carried out in methanol, a highly nucleophilic solvent, it was assumed that no carbonium ion was formed in the reaction. It is also known that tertiary phosphites and t-alkyl hydroperoxides react to give only one phosphate and one alcohol.

On the basis of these, and other experiments, two reaction mechanisms were proposed. One involves attack by the phosphine on the peroxide bond with a simultaneous shift of the proton to give the alcohol and the phosphine oxide directly. Alternately, displacement by the phosphine could give a t-alkoxide ion and a hydroxyphosphonium ion, which could then give rise to the products by proton transfer.

Microfilm \$2.50; Xerox \$4.40. 82 pages.

- I. THE REACTION OF ORGANIC DISULFIDES WITH LEAD TETRAACETATE.
- II. STUDIES IN THE CHEMISTRY OF GEMINAL DITHIOLS AND RELATED COMPOUNDS.

(L. C. Card No. Mic 60-1388)

Charles Bernard Hoelzel, Ph.D. Vanderbilt University, 1960

Supervisor: Professor Lamar Field

Part I

The product of the reaction of \underline{n} -pentyl disulfide with lead tetraacetate in chloroform-methanol solution has been shown to be methyl \underline{n} -pentanesulfinate (IV). The saponification equivalent, elementary

I: R = phenyl

III: R = p-tolyl

II: R = benzothiazolyl

IV: R = n-pentyl

analysis, molar refraction, and consumption of potassium permanganate are in harmony with values calculated for IV. Two derivatives have been prepared.

A new, convenient, one-step method for the preparation of sulfinic esters has been developed. The procedure has been extended to include three other disulfides. Those used, together with the yields of sulfinic esters realized, are phenyl (79%, I); benzothiazolyl (92%, II); p-tolyl (80%, III); and n-pentyl (35%, IV).

The neutralized samples from the determination of saponification equivalent of I and IV were converted to the corresponding 2,4-dinitrophenyl sulfones. The sample obtained from II could not be so converted, because of decomposition during saponification.

Methyl benzenesulfinate (I) has been found to undergo ready hydrolysis to benzenesulfinic acid and subsequent air oxidation to benzenesulfonic acid. Derivatives of the material at each stage of decomposition have been prepared.

It is suggested that the molar refractivity value (11.05) for the sulfinate group (-S(O)O-) is in error, and a new value (10.59) has been obtained.

The consumption of lead tetraacetate has been found to be approximately three moles to one of disulfide. This information, along with theoretical considerations, has been employed in the proposal of a reaction mechanism. The reaction probably can be represented by the equation:

RSSR + 3 Pb(OCOCH₃)₄ + 4 CH₃OH \rightarrow 2 RS(O)OCH₃ + 3 Pb(OCOCH₃)₂ + 2 CH₃COOCH₃ + 4 CH₃COOH

Part II

Chloral and hydrogen sulfide react to give the previously reported chloral sulfhydrate, rather than the expected 2,2,2-trichloroethane-1,1-dithiol.

Cyclohexanone dibenzyl mercaptol was debenzylated by both aluminum bromide and ferric chloride in benzene to yield diphenylmethane. The expected cyclohexane-1,1dithiol could not be isolated.

Benzaldehyde and thioacetic acid react, in the presence

of polyphosphoric acid, to yield phenylmethanedithiol diacetate in yields up to 61%. Several cleavage reactions were attempted in order to obtain phenylmethanedithiol. Ester interchange with methanol and interchange with glycine were unsuccessful. Interchange with aniline gave the expected acetanilide in 83% yield. The dithiol could not be isolated. Interchange with p-nitroaniline resulted in 83% recovery of p-nitroaniline.

Cyclohexanone and thioacetic acid reacted to give a product which was not cyclohexane-1,1-dithiol diacetate.

It could not be identified.

Microfilm \$2.50; Xerox \$4.60. 89 pages.

NITRATION STUDIES. THE PREPARATION OF α -NITROKETONES. THE REACTION OF NITROPARAFFINS WITH EPOXIDES.

(L. C. Card No. Mic 59-6277)

Takeo Hokama, Ph.D. Purdue University, 1958

Major Professor: G. Bryant Bachman

The preparation of α -nitroketones through C-acylation of nitroparaffin salts was investigated. C-Acylation of primary nitroparaffin salts with acyl cyanides was accomplished and the desired α -nitroketones were obtained in good yields. The mechanism of O- and C-acylation is discussed.

Preparation of α -nitroketones and aldehydes through nitration of enol esters and ethers in the liquid phase was also investigated using various nitrating agents. α -Nitroketones and aldehydes were obtained in fair yields from enol esters and ethers with nitryl chloride.

Alkylation of nitroparaffins with epoxides led through O-alkylation to oximes and β -hydroxyalkyl oxime ethers. A number of these oxime ethers were prepared through alkylation of nitroparaffins and oximes and the oxime ethers prepared by either method were found to be identical. Microfilm \$2.50; Xerox \$6.80. 142 pages.

THE PREPARATION OF INTERMEDIATES FOR USE IN THE SYNTHESIS OF STEROIDS

(L. C. Card No. Mic 60-1434)

Arthur E. Jacobson, Ph.D. Rutgers University, 1960

Major Professor: Dr. Roderick A. Barnes

A method for the synthesis of a highly unsaturated tetracyclic molecule, with an oxygen atom at positions 1, 3 and 10, has been described. This molecule can be converted into 18:19-bisnor-D-homoandrostane-3,11,17a-trione by various stereospecific hydrogenations.

The procedure involved the alkaline fusion and subsequent methylation of 1-naphthol-8-sulfonic acid to form 1,7-dimethoxynaphthalene. This product was converted into 2-hydroxymethyl-3,5-dimethoxynaphthalene, and this

was treated with thionyl chloride to form 2-chloromethyl-3,5-dimethoxynaphthalene. A condensation with ethyl α-carbethoxysuccinate gave 3,3-dicarbethoxy-4-(3',5'dimethoxy-2'-naphthyl-) ethyl butyrate. This triester was saponified and decarboxylated to form 3-carboxy-4-(3',5'dimethoxy-2'-naphthyl-)butanoic acid. A cyclization was accomplished through the use of polyphosphoric acid, and it gave 8,10-dimethoxy-4-keto-1,2,3,4-tetrahydrophenanthrene-2-carboxylic acid. The ketone moiety was reduced with palladium on charcoal at 65°, and the resulting carboxylic acid was converted to 2-methylene-8,10-dimethoxy-1,2,3,4-tetrahydrophenanthrene by a Chugaeff reaction. This compound was ozonized to form 8,10dimethoxy-1,2,3,4-tetrahydrophenanthrenone-2. The ketone was treated with the methiodide salt of 1,1-diethylaminobutanone-3 to give the desired tetracyclic compound 1,3-dimethoxy-10-keto-7,8,10,11,12,13-hexahydrochrysene. Microfilm \$2.50; Xerox \$4.80. 91 pages.

I. AN OXYGEN-18 TRACER STUDY OF THE ISOMERIZATION OF CYCLOPROPYLCARBINYL BENZENESULFONATE.

II. AN APPROACH TOWARDS A STUDY OF THE STEREOCHEMISTRY OF ELECTROPHILIC SUBSTITUTION AT A SATURATED CARBON ATOM. III. ATTEMPTED SYNTHESES OF

UNSYMMETRICALLY SUBSTITUTED BENZOIC ANHYDRIDES.

(L. C. Card No. Mic 60-1437)

Eugene John Kupchik, Ph.D. Rutgers University, 1960

Major Professor: Donald B. Denney

PART I

Cyclopropylcarbinyl benzenesulfonate (I), labeled with excess oxygen-18 in the ether position of the ester group, was isomerized to 3-butenyl benzenesulfonate (II). Hydrogenation of (II) followed by reductive cleavage with sodium in liquid ammonia gave n-butyl alcohol which contained one-third of the excess oxygen-18 originally present in (I). This indicates that complete equilibration of the oxygen-18 occurred during the isomerization of (I) to (II). Possible mechanisms to account for the oxygen-18 equilibration are discussed.

PART II.

Reaction of triethyltin-lithium with α -phenethyl chloride in ether gave meso-2,3-diphenylbutane. The formation of this compound suggests the occurrence of a halogen-metal interconversion reaction.

Reaction of triphenyltin-sodium with α -phenethyl chloride in liquid ammonia gave triphenyl α -phenethyltin (31.6%) and hexaphenylditin (31.6%). The triphenyl α -phenethyltin is a new organotin compound.

Reaction of triphenyltin-sodium with triphenyltin iodide in liquid ammonia gave a mixture of products from which was isolated tetraphenyltin.

Reaction of triphenyltin-sodium with 2-bromoöctane in liquid ammonia gave tetraphenyltin (21.8%), hexaphenylditin oxide (16.0%) and triphenyl 2-octyltin (11.4%).

Reaction of triphenyltin-sodium with α -phenethyl chloride, $\alpha_{\rm D}^{25}$ + 98.9° (1 = 1 dm., no solvent), in liquid ammonia gave triphenyl α -phenethyltin, $\left[\alpha\right]_{\rm D}^{27.5}$ -1.39°.

Treatment of crude trimethyl α -phenethyltin with hydrogen chloride gas at 130-135° gave ethylbenzene and dimethyltin dichloride.

Treatment of a solution of crude trimethyl α -phenethyltin in chloroform at -78° with hydrogen bromide gas gave ethylbenzene.

Reaction of trimethyltin-sodium with α -phenethyl chloride, α_D^{25} + 98.9° (1 = 1 dm., no solvent), gave crude trimethyl α -phenethyltin, $[\alpha]_D^{18}$ + 3.72°. Since the trimethyl α -phenethyltin was not isolated in pure form, this value could be in error owing to the presence of unreacted (+)- α -phenethyl chloride.

Treatment of a solution of crude trimethyl α -phenethyltin, $[\alpha]_D^{18} + 3.72^{\circ}$, in chloroform at -78° with deuterium bromide gas gave racemic α -deuteroethylbenzene.

No conclusion regarding the stereochemistry of electrophilic substitution at a saturated carbon atom can be made from the results of this research. However, since it has been shown that the configuration of an optically active center next to a tin atom can apparently be related to the sign of rotation of the compound, complete resolution of the compound would enable solution of the problem.

A scheme for resolving trimethyl α -phenethyltin is suggested.

PART III.

Although carried out under a wide variety of conditions, the reaction of p-nitrobenzoyl chloride with silver benzoate failed to yield pure p-nitrobenzoic benzoic anhydride. The contaminant appeared to be p,p'-dinitrobenzoic anhydride. Other standard procedures for preparing mixed anhydrides also failed to yield a pure sample of p-nitrobenzoic benzoic anhydride.

o-Nitrobenzoic benzoic anhydride was obtained in pure form from the reaction of o-nitrobenzoic acid with benzoyl chloride in pyridine.

m-Nitrobenzoic benzoic anhydride was obtained in pure form from the reaction of m-nitrobenzoic acid with benzoyl chloride in pyridine and also from the reaction of m-nitrobenzoyl chloride with silver benzoate.

Reaction of m-Nitrobenzoyl chloride-CO¹⁸Cl with silver benzoate in ether at 0° gave m-nitrobenzoic benzoic anhydride in which the oxygen-18 was completely randomized. Microfilm \$2.50; Xerox \$5.80. 116 pages.

PHOTOOXIDATION OF SOME SYMMETRICAL OLEFINS

(L. C. Card No. Mic 60-1366)

William Charles Landgraf, Ph.D. Stanford University, 1960

The goal of the present investigation is an attempt to establish clearly the products and course of photooxidation of certain olefins. In order to obtain information subject to a minimum of ambiguity in interpretation, the symmetrical olefins 3-hexene and cyclohexene were selected for these oxidations. Since much kinetic work on thermal and photoinitiated oxidations has been reported in the literature, with results subject to a variety of interpretations, product identification was considered as potentially capable of offering greater promise as a means of avoiding mechanistic ambiguities.

Oxidations of both cyclohexene and 3-hexene were carried out in quartz vessels irradiated with ultraviolet light. Product separation was achieved both through vapor-liquid partition chromatography and conventional partition chromatography. Infrared spectra, physical properties and analytical data provided the means for identification of the various oxidation products which were separated by the chromatographic techniques.

Cyclohexene-3-one, cyclohexene-3-ol and trans-1,2-cyclohexanediol were identified as the principle low molecular weight photooxidation products of cyclohexene. Formaldehyde, acetaldehyde, propionaldehyde, butyraldehyde and acetone were isolated and characterized as 3-hexene photooxidation products.

The appearance of cyclohexene-3-one and its corresponding alcohol is envisaged as having resulted from photoengendered alkoxy radicals, via intermediate cyclohexene 3-hydroperoxide, reacting with other radicals and substrate molecules in the reaction mixture. To check for the existence of these photoengendered alkoxy radicals, photolyses of a number of hydroperoxides was carried out in an electron paramagnetic resonance spectrometer. By this means identification of several alkoxy radicals as well as the cyclohexeneoxy alkoxy radical was achieved and the half-life of the latter is estimated. The trans-1,2-cyclohexanediol apparently results from a radical attack on an intermediate epoxycyclohexane. The latter was not isolated, but has been detected by other investigators.

The formation of lower aldehydes and ketonic products during photooxidation of 3-hexene cannot be rationalized by the preceding scheme. To account for these observed products it was found convenient to postulate a mechanism involving a cyclic peroxide intermediate of a sort previously postulated and in certain cases isolated by earlier investigators. The isolation of such an intermediate in the present study, however, was not achieved. Subsequent decomposition of this cyclic peroxide intermediate may then yield the aldehydes observed. Such a mechanism is also capable of explaining the products formed during photooxidations of a number of other olefins reported in the literature.

The appearance of acetone during 3-hexene photo-oxidation is envisioned as arising by reaction of an initial 3-hexeneoxy radical with other radical species in its environment, followed by fission of the resulting intermediate into products.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

THE STEREOCHEMISTRY OF RADICAL ADDITION REACTIONS

(L. C. Card No. Mic 60-1497)

Donald Wayne Larsen, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Harlan L. Goering

Previous work has shown that the radical-chain addition of HBr to 1-bromocyclohexene, 1-chlorocyclohexene or 1-methylcyclohexene is stereoselective. The products of trans-addition, cis-1,2-disubstituted cyclohexanes, are formed almost exclusively. The purpose of the present work was to determine (a) if the radical-chain addition of sulfhydryl compounds to 1-chlorocyclohexene is as stereoselective as the addition of HBr, and (b) if the radical-chain addition of HBr (or DBr) to the acyclic olefins, cis and trans-2-bromo-2-butene, is stereospecific. Some additional problems related to those above have been studied as well.

The radical-chain additions of hydrogen sulfide, thiophenol and thioacetic acid to 1-chlorocyclohexene proceed readily when initiated with ultraviolet light. These additions give 1,2-disubstituted cyclohexanes and the configurational compositions of the 1:1 adducts were determined by selective solvolysis of the more reactive trans isomers. Under the conditions of the present experiments the addition of hydrogen sulfide to 1-chlorocyclohexene gives primarily cis-2-chlorocyclohexanethiol, together with small amounts of the trans isomer (7.5 to 14.1%) and some of the bis-2-chlorocyclohexyl sulfide. The addition of thiophenol similarly results in the preponderant formation of cis-2-chlorocyclohexyl phenyl sulfide (0.9 to 5.8% trans). The addition of thioacetic acid gives a mixture of cis and trans-2-chlorocyclohexyl thiolacetates containing about 30% of the trans isomer. In each case the stereoselectivity apparently depends upon the ratio of addendum to 1-chlorocyclohexene.

Subsequently it was found that the 2-chlorocyclohexyl phenyl sulfide was contaminated with considerable amounts of phenyl disulfide. Upon re-examination of the reaction it was found that hydrogen was evolved when a mixture of thiophenol with 1-chlorocyclohexene or cyclohexene was irradiated. Gas chromatographic analysis showed that some of the cyclohexene was reduced to cyclohexane. Therefore it was concluded that large amounts of thiyl radicals and hydrogen atoms were produced by the initiation reaction. The former can combine to form phenyl disulfide in addition to adding to the olefin. The latter can abstract hydrogen atoms from addendum or olefin to produce hydrogen gas or add to the double bond, thus leading to reduction of the olefin.

The radical-chain additions of HBr and DBr to the isomeric 2-bromo-2-butenes are carried out at -78° with the olefin dissolved in excess liquid addendum, or at higher temperatures with saturated solutions of the addendum in the olefin. At -78° the additions are completely stereospecific and the trans-addition products are obtained. As the reaction temperature is increased, i.e. as the amount of addendum in the liquid phase decreases, the stereospecificity diminishes. At room temperature the reactions are non-stereospecific. Under all conditions the degree of stereospecificity appears to be about the same for HBr and DBr. At -78° the rate of addition of

HBr is 2.4 times the rate of addition of DBr. It is concluded that the stereospecific radical-chain addition requires the reaction of bromine atoms with olefin-HBr pi complexes.

Similarly the radical-chain addition of HBr to the isomeric 2-chloro-2-butenes is stereospecific at -78° but

not at room temperature.

The radical-chain addition of HBr to 1-chlorocyclopentene is stereoselective even at room temperature with low addendum concentrations. This could indicate that the reaction of HBr with the intermediate 1-chloro-2-bromocyclopent-1-yl radical is stereoselective, or that this reaction does not occur and that the product is formed by the reaction of bromine atoms with an olefin-HBr pi complex.

The radical-chain addition of HBr to 2-chloronorbornene is unusual in that the product of <u>cis</u> addition predominates.

In each of the above cases the ionic addition of HBr to the olefin competed strongly with the radical-chain addition when excess HBr was present.

Microfilm \$2.50; Xerox \$6.20. 128 pages.

NITRATION STUDIES. LIQUID AND VAPOR PHASE HALONITRATIONS OF HALOGENATED OLEFINS.

(L. C. Card No. Mic 59-6271)

Ted J. Logan, Ph.D. Purdue University, 1958

Major Professor: G. Bryant Bachman

This investigation was first concerned with the liquid phase reaction of vinyl halides with solutions of halogens and dinitrogen tetroxide. Specifically, these studies showed that the reaction of vinyl chloride or vinyl bromide with chlorine, bromine, or iodine, and dinitrogen tetroxide led to 1,1-dihalo-2-nitroethanes. The structures of these compounds were shown by their conversion to halogenated acetic acids by acid hydrolysis and by the products formed from their reaction with sodium anthranilate. The orientation of the addition suggests that the olefin first adds an NO₂ radical and then a halogen atom to form the final product.

Vinyl chloride was then reacted with chlorine and nitrogen dioxide in the vapor phase in the temperature range of 300-350° at various mole ratios to produce 1,2-dichloro-1-nitroethane. This compound was converted to 2-chloro-2-nitroethanol by reaction with steam and converted to polymeric 1-chloro-1-nitroethylene by reaction with aqueous sodium bicarbonate. Substitution of bromine for chlorine in the above reaction gave 2-bromo-1-chloro-1-nitroethane. These are free radical reactions initiated by attack of the halogen atom. The resulting dichloroethyl radical then unites with nitrogen dioxide to give the final product.

Vinyl bromide was reacted with chlorine and nitrogen dioxide to yield 1-bromo-1-chloro-2-nitroethane and with bromine and nitrogen dioxide to give 1,1-dibromo-2-nitroethane, both reactions being carried out at 250°. The products obtained in the halonitrations of vinyl bromide showed that, under the conditions of these reactions, attack

was initiated by the NO₂ radical rather than by a halogen atom.

As in the liquid phase, the structures of the vapor phase products were shown by hydrolysis to halogenated acetic acids and by the derivatives obtained from their reaction with sodium anthranilate.

The mechanisms of the above reactions have been correlated and rationalized.

Microfilm \$3.65; Xerox \$12.85. 283 pages.

THE REACTION OF DIAZONIUM SALTS WITH ALDEHYDE ARYLHYDRAZONES: THE MECHANISM OF FORMAZAN FORMATION.

(L. C. Card No. Mic 60-1271)

Steven Gerald Plovan, Ph.D. Kansas State University, 1960

Earlier work on the reaction of diazonium salts with aldehyde arylhydrazones resulted in the isolation of an intermediate to which a tetrazene structure was assigned. On the basis of tetrazene as a necessary intermediate the mechanism of the reaction was formulated as attack of diazonium ion at the saturated nitrogen of an arylhydrazone followed by intramolecular rearrangement without dissociation to produce a formazan.

The reaction of indazole, a compound similar to a phenylhydrazone, with diazonium ion to produce 3-arylazo indazoles cannot take place via the tetrazene intermediate, unless dissociation takes place, due to the spatial requirements of the transition state. Because indazole does form 3-arylazo derivatives, which are essentially formazans, the mechanism must be in error.

Examination of the cleavage reaction which takes place when the isolable intermediates are treated with hydrochloric acid suggested that rather than being tetrazenes, the intermediates were in fact bis-arylazo compounds.

The structure of the intermediate was determined by nuclear spin resonance (NSR) spectroscopy. By cataloging the spectra of several types of azo compounds and hydrazones, it was possible to predict the peak values for a bis-azo structure. The spectrum of the intermediate was found to be in good agreement with the one predicted for the bis-azo structure.

Knowing the structure of the intermediate, it is possible to write a new mechanism for the coupling reaction which explains all of the available data. Assuming a second order reaction, as are most diazonium coupling reactions, diazonium ion attacks the methine carbon of the aryl-hydrazone while base abstracts the proton from the nitrogen of the hydrazone to produce a bis-arylazo compound. The bis-azo compound then tautomerizes to a formazan.

The formazans obtained by tautomerism of the <u>bis-azo</u> compounds appear to be isomeric with those obtained without isolation of the intermediate. Crystallization of those formazans obtained from the intermediate products converts them to the identical compound obtained when no intermediates are isolated.

NSR spectra indicate that tautomerism of the bis-azo structure leads to a formazan having the cis-azo structure and the anti configuration about the C-N double bond

(cis-anti). On crystallization the cis-anti compound isomerizes to the more stable trans-syn structure which, on irradiation with light, is converted to the cis-syn isomer. In the absence of light the cis-syn structure isomerizes to the trans-syn. These assignments must be considered only tentative as they are based upon the assumption that the formazans can be compared to azobenzenes and azotoluenes.

Microfilm \$2.50; Xerox \$6.00. 123 pages.

ACYCLIC GLYCOLYCARBINOLS AND RELATED COMPOUNDS DERIVED FROM ETHYL PYRUVATE DIETHYL KETAL

(L. C. Card No. Mic 60-1519)

Stephen Leonard Razniak, Ph.D. Washington State University, 1960

Supervisor: Dr. Gardner W. Stacy

One objective of this investigation was to devise a more general synthesis of acetylcarbinols. A new route to acetylcarbinols (where $R_1 = R_2$) which involved the reaction of Grignard reagents with ethyl pyruvate diethyl ketal

$$\begin{array}{c|cccc}
CC_2H_5 & & R_1 \\
CH_3C & CO_2C_2H_5 & & 1. & 2RMgX \\
CC_2H_5 & & 2. & H^{\textcircled{\textcircled{\scriptsize 0}}} & R_2 & C & CCH_3 \\
\hline
CC_2H_5 & & OH & O
\end{array}$$

was developed. The reaction was carried out initially in the ethyl series. The reaction proceeded smoothly, and the acetylcarbinol was obtained in good yield. The structure of the acetylcarbinol was confirmed by an independent synthesis involving the hydration of 3-ethyl-1-pentene-3-ol.

The second objective of this study was to investigate the intermediates formed in the reaction of ethyl pyruvate diethyl ketal with various Grignard reagents. Davis, who first isolated the intermediate in the reaction of butylmagnesium bromide with ethyl pyruvate diethyl ketal, postulated that the intermediate was an enol ether. The corresponding intermediate in the reaction of ethylmagnesium bromide and ethyl pyruvate diethyl ketal was isolated, and its structure was shown to be that of the enol ether 2-ethoxy-3-ethyl-1-pentene-3-ol. The scope of the reaction was established by the synthesis of enol ethers from two very different Grignard reagents. When an attempt was made to isolate the intermediate in the reaction of sec-butylmagnesium bromide with ethyl pyruvate diethyl ketal, an enol ether was not obtained. Instead, a hydroxy ketal (3-hydroxy-4-methyl-2-hexanone diethyl ketal) was isolated. The formation of this product rather than the enol ether has been tentatively attributed to steric hindrance preventing attack of the Grignard at the terminal methyl group to give the enol ether.

The third part of this work was concerned with the saponification of 3-ethyl-3-hydroxy-1-(p-nitrobenzoxy)-2-pentanone, a key intermediate, to the corresponding glycolycarbinol. A procedure developed previously gave very poor results (5%). It was found that a 60% dioxane-40% water solvent system allowed the conversion to take place in good yield (53%).

$$(C_{2}H_{5})_{2}C - CCH_{2}Br \xrightarrow{K\Theta\ThetaO_{2}CC_{6}H_{4}NO_{2}-p} (C_{2}H_{5})_{2}C - CCH_{2}OCOC_{6}H_{4}NO_{2}-p$$

$$OH O O OH O$$

$$p-O_{2}NC_{6}H_{4}CO_{2}Cl \downarrow Ba(OH)_{2}$$

$$Dioxane-Water$$

$$Ba(OH)_{2}, Dioxane-Water OH O$$

$$C_{2}H_{3})_{2}C - CCH_{2}OH$$

$$OH O$$

Further work showed that 1-bromo-3-ethyl-3-hydroxy-2-pentanone could be converted directly to the glycolycarbinol; this eliminates the necessity of a p-nitrobenzoate intermediate. It was not found possible to carry out the displacement of bromine by hydroxyl in good yield using several other solvents and/or bases.

The reconversion of 1,3-dihydroxy-3-ethyl-2-pentanone to its \underline{p} -nitrobenzoate precursor coupled with its infrared spectrum firmly established the dehydroxyketone structure of 1,3-dihydroxy-3-ethyl-2-pentanone.

Microfilm \$2.50; Xerox \$3.00. 37 pages.

1. G. T. Davis, Thesis, Washington State University (1957).

THE ALKYL NITRATE NITRATION OF ALIPHATIC NITRILES AND KETONES

(L. C. Card No. Mic 59-6276)

Christos Savides, Ph.D. Purdue University, 1958

Major Professor: Henry Feuer

As part of a program to study the scope of the alkyl nitrate nitration of active methylene compounds, the nitration of aliphatic nitriles and ketones was investigated. Butyronitrile, hexanenitrile and acetophenone were reacted with amyl nitrate, in the presence of potassium t-butoxide, to give the potassium salts of α -nitrobutyronitrile, α -nitrohexanenitrile and 2-nitroacetophenone, respectively. Similarly, the dinitration of adiponitrile, pimelonitrile, suberonitrile, sebaconitrile, 4-heptanone, ethyl methyl ketone and acetone afforded the dipotassium salts of the corresponding α,α' -dinitro nitriles and α,α' -dinitro ketones. It was found that best yields in the above nitration reactions were obtained with tetrahydrofuran, as solvent, and reaction temperatures of -40 to -50°.

In order to investigate the properties and reactions of the above products, which have not been previously described, dipotassium a,a'-dinitroadiponitrile (I) was reacted with methyl vinyl ketone at a pH of 7-8 to give the adduct, 5,8-dicyano-5,8-dinitro-2,11-dodecanedione (II). Hydrolysis of I under alkaline conditions, followed by acidification and subsequent decarboxylation, afforded 1,4-dinitrobutane (III). The reaction of I with formaldehyde resulted only in trace amounts of the expected 2,5-dicyano-2,5-dinitro-1,6-hexanediol (IV). The latter was identified by conversion to its diacetoxy derivative, diacetoxy 2,5-dicyano-2,5-dinitrohexane (V).

The properties and reactions of the bromination products derived from dipotassium α,α' -dinitroadiponitrile (I) were investigated. Bromination of I, under anhydrous conditions or in water, afforded α,α' -dibromo- α,α' -dinitroadiponitrile

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(VI). Compound VI upon hydrolysis in aqueous potassium hydroxide at 70° was converted to 1,1,4,4-tetrabromo-1,4-dinitrobutane (VII). The latter compound VII was also obtained by the bromination of I under alkaline conditions at 70°. It was established that 2,5-dibromo-2,5-dinitropentanamide (VIII) was an intermediate in the conversion of VI to VII and also in the bromination of I to VII. Thus treatment of VI with base at -5°, followed by acidification gave the amide VIII, which upon further treatment with base at 25° was converted to VII. Bromination if I, under alkaline conditions at 0°, followed by acidification, also formed VIII. Hydrolysis of VI, in aqueous hydrochloric acid afforded, instead of the expected 1,4-dibromo-1,4dinitrobutane, succinic acid (IX).

The Michael type addition of dipotassium α,α' -dinitrocyclic ketones to methyl vinyl ketone was investigated. Dipotassium 2,5-dinitrocyclopentanone (X) was reacted with methyl vinyl ketone in aqueous methanol at a pH of 7-8. The product, however, was not the expected 2,5dinitro-2,5-bis-(3-oxobutyl)cyclopentanone (XI). Instead, ring opening occurred and 5,8-dinitro-5,8-bis(3-oxobutyl)-2,11-dodecanedione (XII) was isolated. The identity of the latter was established by the fact that XII was prepared in an independent synthesis by the reaction of 1,4-dinitrobutane and methyl vinyl ketone. Dipotassium 2,6-dinitrocyclohexanone (XIII) similarly reacted with methyl vinyl ketone to give the open-chain compound 5,9-dinitro-5,9-

bis(3-oxobutyl)-2,12-tridecanedione (XIV).

The infrared spectra of the salts of nitro paraffins, α -nitro ketones, α , α '-dinitro ketones, α -nitro nitriles and α,α'-dinitro nitriles were studied and an empirical correlation was made, regarding the characteristic bands of these compounds. The sodium salts of nitro paraffins, except sodium nitromethane, indicated the presence of four common bands in the regions of 1605-1587 cm 1175-1155 cm⁻¹, 1153-1116 cm⁻¹ and 734-700 cm⁻¹. These bands are the strongest bands in their respective spectra, and are not present in the infrared spectra of the parent nitro paraffins.

The effect of the nitro group in the infrared spectra of the salts of α -nitro ketones is evidenced by the fact that the carbonyl stretching vibration is shifted to lower fre-Microfilm \$2.55; Xerox \$8.80. 193 pages.

STUDIES IN THE CHEMISTRY OF CERTAIN ORGANIC SULFIDES, DISULFIDES AND SULFONES.

(L. C. Card No. Mic 60-1393)

William David Stephens, Ph.D. Vanderbilt University, 1960

Supervisor: Professor Lamar Field

PART I. THE CHEMISTRY OF o-PHENYLENE DISULFIDE AND RELATED COMPOUNDS

Two new heterocyclic compounds have been synthesized and their structures elucidated. The synthesis of one of these, 3,4,7,8-dibenz-1,2,5,6-tetrathia-3,7-cyclooctadiene (o-phenylene disulfide), was the original objective of this work. o-Phenylene disulfide was synthesized from dithiocatechol by oxidation with iodine (the maximum yield was 17%). The proof of structure rests mainly on determina-

tion of molecular weight, on elemental analysis and on demonstration of the absence of the sulfhydryl group. The determination of molecular weight was done in these laboratories by four different methods: ebullioscopically in chloroform, in carbon disulfide and in benzene, and cryoscopically in camphor. Independent checks were done by a commercial analyst. All values were in good agreement with the theoretical value for o-phenylene disulfide. The absence of the sulfhydryl group was demonstrated by use of the iodine-sodium azide reagent.

The polymerization tendencies of o-phenylene disulfide were studied, and it was determined that polymerization occurred at temperatures above 146° and in benzene solution. At temperatures below 120° the material was stable for a period of several hours, but polymerization occurred

on standing for several weeks at 25°.

The infrared and ultraviolet absorption spectra of o-phenylene disulfide were studied, and no features were encountered which would be considered incompatible with the proposed structure. The ultraviolet absorption spectrum of o-phenylene disulfide is quite similar to that of phenyl disulfide.

The second heterocyclic compound, 2,4-diphenyl-6,7benzo-1-thia-5-aza-4,6-cycloheptadiene, was obtained by the reaction of benzalacetophenone with o-aminobenzenethiol with piperidine followed by acetic acid catalysis. Another product of the same reaction was β -phenyl- β -(o-aminophenylmercapto) propiophenone which was cyclized to the cycloheptadiene derivative in 78% yield. This heterocyclic compound was an unexpected product in one of a series of reactions intended to produce o-phenylene disulfide, the eight-membered ring compound mentioned above.

PART II. THE CHEMISTRY OF CERTAIN ORGANIC SULFIDES

The question of whether the isosteric relationship between an olefinic bond and a sulfide linkage extends to chemical properties has been investigated. The Zerevitinow active-hydrogen determination and bromination attempts with N-bromosuccinimide have been used to determine whether hydrogen atoms situated α to a sulfide linkage show activation resembling that of allylic hydrogen atoms. Results indicated that the isosteric relationship does not extend to chemical properties.

PART III. THE OXIDATION OF CERTAIN SULFONES

The possibility of utilizing α -hydroxy sulfones for the synthesis of poly-carbonyl compounds has been investigated. Several attempts have been made to synthesize the intermediate a-hydroxy sulfones. Acetoxylation reactions of sulfones with lead tetraacetate gave no pure products and apparently resulted in rather general oxidation of sulfones. Oxidation of ketosulfones with potassium permanganate and manganese dioxide also proved not to be entirely specific and resulted in cleavage rather than in oxidation of a hydrogen atom to a hydroxyl group. Oxidation of the Grignard reagent of dibenzoyl-(phenylsulfonyl)-methane with t-butyl hydroperoxide also seemed unpromising. In general, results did not seem to indicate that this route to poly-carbonyl compounds was feasible. Microfilm \$2.50; Xerox \$5.20. 102 pages.

A STUDY IN PYROLYSIS OF 1,3-CARBONATE ESTERS AS A ROUTE TO FUNCTIONAL DERIVATIVES OF OXETANE.

(L. C. Card No. Mic 60-1274)

Peter Eugene Throckmorton, Ph.D. Kansas State University, 1960

The purpose of this work was to study possible synthetic approaches to functionally substituted oxetanes such as 3-hydroxymethyloxetane, 3-methyleneoxetane, 3-oxetanecarboxylic acid and related compounds.

A method for pyrolysis of 2,2-dialkyl-1,3-propylene carbonates to 3,3-dialkyloxetanes, using potassium carbonate as a catalyst, was discovered. Application of the method to the synthesis of 3-methyleneoxetane led instead to the isomeric methacrolein. This result was obtained on pyrolysis of either the cyclic, monomeric form or the polymeric form of the precursor, 2-methylene-1,3-propylene carbonate. Pyrolysis of this carbonate in the absence of catalyst also led to methacrolein. This is considered a new mode of 1,3-carbonate decomposition.

Attempted synthesis of 3-bromomethyl-3-methyloxetane and 3-hydroxymethyl-3-hydroxyoxetane by pyrolysis of appropriate 1,3-carbonate esters led to products other than oxetanes, such as 1,1-bis(hydroxymethyl)ethylene oxide on pyrolysis of carbonate ester of tris(hydroxymethyl)methanol.

By-products in the carbonate pyrolysis were olefin and formaldehyde. To investigate the possibility of their being formed from the oxetanes themselves a study of gas phase thermal decomposition of a series of 3,3-disubstituted oxetanes was made. Temperature requirement was 450° for appreciable decomposition of 3,3-diethyloxetane, the least stable of the series. In every case tested only terminal olefin and formaldehyde decomposition products were isolated. No isomerization to 2,2-disubstituted propionaldehydes was observed. This indicated that in the synthesis of oxetanes by 1,3-carbonate pyrolysis, decomposition of oxetane product is not important.

Several attempts to prepare tris(hydroxymethyl)methane, a precursor for 3-hydroxymethyloxetane, were unsuccessful. The reaction of nitrous acid with tris(hydroxymethyl)aminomethane followed by catalytic hydrogenation of the aldehyde product led to tris(hydroxymethyl)methanol instead of the expected tris(hydroxymethyl)methane. Other unsuccessful approaches were aldol condensation of formaldehyde with acetaldehyde, lithium aluminum hydride reduction of tricarbethoxymethane, and alkaline cleavage of pentaerythritol.

Potassium 3-(3-methyloxetane)carboxylate was obtained by permanganate oxidation of 3-hydroxymethyl-3-methyloxetane. This is believed to be the first reported 3-oxetanecarboxylate salt.

Some reactions of 3-hydroxymethyl-3-methyloxetane were studied to investigate small ring-hydroxyl intramolecular interaction. Various esterifications at the hydroxymethyl site proceeded smoothly, with some or no ring cleavage, depending on conditions. Several new esters obtained were characterized. Lithium aluminum hydride reduction of 3-hydroxymethyl-3-methyloxetane effected the expected ring cleavage to 2,2-dimethyl-1,3-propanediol in high yield. The absence of any pronounced intramolecular ring-hydroxyl interaction in 3-hydroxymethyl-3-methyloxetane led to postulation of a new mechanism of

decomposition of 2-hydroxymethyl-substituted 1,3-carbonate esters. Microfilm \$2.50; Xerox \$8.40. 185 pages.

DEUTERIUM ISOTOPE EFFECTS IN THE REACTIONS OF TRANS-STILBENE. THE ALPHA DEUTERIUM EFFECT.

(L. C. Card No. Mic 60-1456)

Norman Tunkel, Ph.D. Rutgers University, 1960

Major Professor: Donald B. Denney

Recently, considerable interest has been focused on alpha deuterium isotope effects. In general, the studies have been concerned with the isotope effects found on comparing the S_N1 and S_N2 reactions on alpha deuterated and undeuterated substances. It has now been found that such effects exist in simple addition reactions to deuterated and undeuterated olefins. The olefin chosen was trans-stilbene and its deuterated counterpart, which was prepared by catalytic deuteration of diphenylacetylene.

The isotope effects were measured in all cases but one by the method of competitive reactions, i.e. a mixture of labeled and unlabeled olefin was allowed to incompletely react and the unreacted starting material, and in some cases the product, were analyzed for deuterium. From these data and the extent of reaction it was possible to evaluate the isotope effects. The following isotope effects (k_H/k_D) were obtained: 0.91 for the addition of bromine in ether at -78°; 0.87 for the addition of 2,4-dinitrobenzenesulfenyl chloride in acetic acid at 25°; 0.93 for the addition of ozone in ethanol at 25°; 0.82 for oxidation by potassium permanganate in acetone at -5°; 0.88 for oxidation of tetrachloro-o-benzoquinone in benzene at 80°; and 0.89 for epoxidation by peracetic acid in chloroformacetic acid at 25°.

The kinetics of epoxidation of labeled and unlabeled $\frac{\text{trans}}{\text{-stilbene}}$ were also measured in chloroform at $\frac{29.7^{\circ}}{\text{-stilbene}}$. The isotope effect found by this method was 0.91. All of the isotope effects were measured at least twice, and in most cases relatively good checks were obtained.

It should be emphasized that no attempts to use these data for quantitative comparisons and interpretations could be made since in some of the systems the extent of reaction is subject to incompletely evaluated errors. The data do show that inverse isotope effects do exist in these systems and are in accord with the work of W. G. Miller¹ who found similar effects in the fumarase catalyzed addition of water to fumarate and maleate ion.

The origin of these isotope effects most probably arise from differences in the changes of energy associated with the carbon-hydrogen and carbon-deuterium vibrational frequencies in the ground states and transition states,^{2,3} and agree with the observations and theoretical calculations of Streitwieser et al.

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 Microfilm \$2.50; Xerox \$3.80. 68 pages.

CHEMISTRY, PHARMACEUTICAL

A COMPARATIVE STUDY OF THE EFFECT OF NON-IONIC SURFACTANTS ON THE RELEASE OF MEDICATION FROM OINTMENT BASES

(L. C. Card No. Mic 59-6260)

Donald Young Barker, Ph.D. Purdue University, 1955

Major Professors: H. George DeKay and John E. Christian

Hydrophilic Ointment U. S. P. XIV has been reported to possess undesirable irritation properties due to the anionic surfactant, sodium lauryl sulfate. Accordingly, the United States Pharmacopeia Revision Committee recommended the replacement of this surfactant with available non-ionic surfactants. The objective of this project was to determine the effect of this replacement with non-ionic surfactants in varying concentration on the release of incorporated medication from Hydrophilic Ointment.

Hydrophilic Ointments were prepared from formulations containing thirteen commercial non-ionic surfactants previously reported to possess enhanced emulsifying properties. The surfactants employed were PEG 1000 MS^a, PEG 600 ML^a, Tween 20^b, Tween 40^b, Tween 60^b, G-7596-J^b, G-7596-P^b, G-1045^b, G-2162^b, Brij 35^b, Myrj 49^b, Ethomid C/15^c, and Tergitol Dispersant NPX^d. These surfactants were substituted in the Hydrophilic Ointment U. S. P. XIV formulation in four concentrations --1, 3, 5 and 7 per cent. In the formulation containing 1 per cent surfactant, the surfactant was the only change made in the formulation. When the remaining surfactant concentrations were employed, a proportional reduction was made in the petrolatum and stearyl alcohol content. Hydrophilic Ointment U. S. P. XIV was used as the standard.

Two medicaments, mercuric oxide and iodine, in a 1 per cent concentration were incorporated into these ointment bases to be tested for release of medication.

The release of medication was determined by the official Food and Drug Administration Agar Plate Method, the resulting zone of inhibition in an agar medium inoculated with a standard culture of <u>Micrococcus pyogenes</u> var. aureus being the criterion for release of medication.

To overcome the inadequacies of the Agar Plate method, a modified procedure employing radioactive tracer technique was introduced. Three surfactants, G-7596-J, Ethomid C/15 and Brij 35, exhibiting maximum medicament releasing ability when tested by the Agar Plate method were selected for study in concentrations of 1, 3 and 5 per cent.

The ointments tested were modified by the incorporation of I-131 labeled iodine. By radioactive tracer technique the release and distribution of the medicament in the surrounding agar medium was determined.

Ointments containing a known amount of activity as CPM were incorporated into agar cups. The plates containing the ointment and the agar were incubated for a period of 24 hours at 37°C. The activity was then determined in each 5 mm. wide concentric circle of agar. From this data and the known activity in the ointment base, the release of medication expressed as per cent of incorporated medication was determined.

The results obtained by this Modified Agar Plate procedure paralleled those obtained by the Agar Plate method. Maximum release of medication was obtained with G-7596-J followed by Ethomid C/15 and Brij 35. The concentration of the surfactant exhibiting this property was 1 per cent. An increase in the concentration of the surfactant caused a decrease in the release of medication. However, at an increased concentration the release of medication was noted to increase once again.

The increased release of medication at a 1 per cent surfactant concentration was due to the increased availability of water in the ointment base formulation at that concentration. However, as the surfactant concentration increased, the availability of the water would subsequently decrease. It was noted, however, that when the surfactant reached a definite concentration, presumably an excess of that required for the emulsification of the ointment ingredients, an affinity of the surfactant for the water in the agar medium resulted in the surfactant diffusing into the agar. Incorporated medication would diffuse along with the surfactant resulting in the increased release of medication at this concentration.

The Modified Agar Plate method of testing the release of medication from ointment bases possesses the advantage of determining the actual release of medication from the ointment base, as well as the distribution of the medication in the agar medium. This method also demonstrated the phenomenon of the medicament diffusing throughout the agar medium and not to the periphery of the zone of inhibition as indicated in the Agar Plate study. The Agar Plate method indicates the area of the agar in which the concentration of the medicament was sufficient to exert a bacteriostatic effect on the incorporated organism, but did not show the true distribution of the medication.

The Modified Agar Plate method of testing release of medication has been applied to the determination of release of medication from two recently developed Hydrophilic Ointments.

Microfilm \$2.50; Xerox \$6.00. 123 pages.

- a. Trademark name of Glyco Products, Inc., Brooklyn, N. Y.
- b. Trademark name of Atlas Powder Co., Wilmington, Delaware.
- c. Trademark name of Carbon and Carbide, Unit of Union Carbide and Carbon Corporation, New York, N. Y.
 - d. Trademark name of Armour and Co., Chicago, Ill.

A STUDY OF THE ANALYSIS OF THE TRIPLE SULFONAMIDES

(L. C. Card No. Mic 59-6258)

Emory Albarte James, Jr., Ph.D. Purdue University, 1955

Major Professor: John E. Christian

The analysis of three sulfonamides, viz., sulfadiazine, sulfamerazine and sulfamethazine, in a mixture using paper partition chromatographic technique in combination with a spectrophotometric determination was investigated.

with a height of 24 inches and an inside diameter of 11 inches was used in this procedure. The chromatographic cylinder was placed in a cylindrical heavy paper carton and shredded paper was packed in the bottom, as well as along the sides between the chromatographic cylinder and the paper carton. This was done in order to decrease the effect of temperature changes and, in so doing, to obtain a more nearly horizontal solvent front.

Following the application and thorough drying of the solutions containing microgram quantities of each of the three sulfonamides on strips of Whatman No. 1 filter paper, which were cut longitudinally from 18 x 22 inch sheets, the strips were suspended from the solvent dish. The organic-aqueous emulsion phase of the solvent system was placed on the bottom of the cylinder. The top of the cylinder was securely attached, and the system was allowed to equilibrate for 8-10 hours. Then the organic phase of the solvent system was added to the solvent dish through the holes in the top of the cylinder which had previously been closed with rubber stoppers. The solvent front slowly progressed down the strips in the usual manner of the descending paper partition chromatographic method.

Each sulfonamide was located on the strips, extracted and the optical density determined spectrophotometrically. The quantity in micrograms of each of the three sulfonamides was determined from the corresponding value of the optical density on the standard curve which was previously prepared.

Since the results of this analysis were not entirely satisfactory for a quantitative method of analysis, another method of analysis was considered.

An inverse isotope dilution technique as applied to this investigation was studied. The reagent, benzenesulfonyl chloride was synthetized starting with labeled H₂S³⁵O₄ and the reagent was found to react quantitatively with each of the three sulfonamides to form definite chemical compounds which were characterized.

A molar excess of $C_6H_5S^{35}O_2Cl$ was reacted with the appropriate sulfonamide. A known weight of carrier, pure non-labeled product, was added to the reaction mixture. With the use of gentle heat and a small quantity of solvent this mixture was placed in solution. After crystallization a weighable quantity of the reaction mixture was isolated and the specific activity was determined. This reaction product was repeatedly recrystallized and the specific activity determined until constant specific activity values were obtained.

Although the results of this method of analysis showed promise as a new analytical procedure for the determination of the sulfonamides, difficulty was encountered in maintaining the necessary reaction yields.

Further investigation will be necessary to widen the range of usefulness of the inverse isotope dilution analysis of the sulfonamides using benzenesulfonyl chloride labeled with Sulfur-35. Microfilm \$2.50; Xerox \$4.80. 95 pages.

A BIOCHEMICAL STUDY OF THE ACID METABOLISM OF BRYOPHYLLUM CALYCINUM SALISB.

(L. C. Card No. Mic 59-6259)

Herbert Lieberman, Ph.D. Purdue University, 1955

Major Professor: Egil Ramstad

The explanation for the unusually high concentration of isocitric acid in Bryophyllum cannot be simply explained by the existence of the Krebs tricarboxylic acid cycle. In fact, the evidence in the literature would point toward a non-operative tricarboxylic acid respiratory cycle in Bryophyllum. The reported high concentration of isocitric acid, the metabolic inertness of isocitric acid, the predominant incorporation of C¹⁴O₂ into malic acid, have all been explained on the basis of the presence in Bryophyllum of a "sluggish" enzyme system. Cis-aconitic acid was not found present in Bryophyllum, a fact which must be interpreted to mean that the conversion of citric to isocitric acid does not occur through the mediation of cis-aconitase, which is necessary in the Krebs tricarboxylic acid cycle.

which is necessary in the Krebs tricarboxylic acid cycle. Evidence from C¹⁴O₂ and 2-C¹⁴ acetate studies, in the presence and absence of malonate and fluoroacetate inhibitors, indicates the Krebs tricarboxylic acid cycle is non-operative in Bryophyllum calycinum. Autoradiograms of the plant extracts showed that the most highly labeled product formed from labeled acetate, with and without inhibitors, was succinate. In no case was citrate or isocitrate labeled as a result of the 2-C¹⁴ acetate imbibition. Pyruvic, oxalacetic, succinic, and fumaric acids were the labeled products of 2-C¹⁴ acetate metabolism in short runs. This same study was performed with tomato as a control plant, which has an operating tricarboxylic acid cycle, and, in contrast to Bryophyllum, the label entered the citrate.

Exposure of Bryophyllum to darkness for 16 hours in an atmosphere of $C^{14}O_2$, revealed mainly the following labeled substances: malic, isocitric, and "oxalsuccinic" acids. Malic acid was by far the most intensely labeled acid. An acid for which there are strong reasons to believe is "oxalsuccinic" acid showed an equal intensity of label, and then one spot identified as predominantly isocitric acid with some citric acid present too.

Several of the organic acids of <u>Bryophyllum</u> were identified by paper partition chromatography and studied under various physiological conditions. Of particular interest in these findings was the presence of large quantities of pyruvic acid.

An attempt to biosynthesize isocitric acid with a specific activity sufficiently high for this acid to serve as a tracer was unsuccessful insofar as it did not have a high specific activity even after four days of contact with C¹⁴O₂. This result indicates that the metabolism of isocitric acid is too inert to be involved in the dynamic reactions required of a respiratory cycle.

Glycolic acid was hypothesized to form a possible condensation product with succinic acid to yield isocitric acid. Labeled glycolic acid was vacuum-infiltrated into Bryophyllum leaf tissue and found not to metabolize into isocitric acid under any of the physiological conditions studied. It was metabolized, however, to form the following radioactive compounds: peptides, serine, glycine,

glyceric acid, alanine, arginine, histidine, and pyruvic acid. Six unknown substances with intense label also appeared on the autoradiograms.

The results of this study indicates the existence of a pyruvate-acetate-succinate-fumarate-malate-oxalacetate-pyruvate dicarboxylic acid cycle in Bryophyllum.

The characteristically high dark conversion of sugars to pyruvic acid in Crassulaceae leaves a relatively large amount of uncompensated hydrogen. This hydrogen "pressure" no doubt will tend to establish in Bryophyllum a ratio of reduced TPN to TPN which is largely in favor of reduced TPN. Consequently, the equilibrium of the

reaction α -ketoglutarate $\stackrel{\text{CO}_2}{=}$ isocitrate is shifted toward

isocitrate. Apparently, a lack of aconitase in <u>Bryophyllum</u> is the reason why isocitric acid is not converted to citric acid, i.e. Krebs tricarboxylic acid cycle is blocked between citric and isocitric acids.

Microfilm \$3.05; Xerox \$10.80. 236 pages.

A POLAROGRAPHIC STUDY OF CERTAIN β -HALOETHYLAMINES

(L. C. Card No. Mic 59-6267)

Roger Mantsavinos, Ph.D. Purdue University, 1957

Major Professor: John E. Christian

A polarographic study has been made of certain aliphatic nitrogen mustards and β -haloethylamine adrenergic blocking agents.

The quaternary nitrogen of physiologically active ethyleneimonium intermediates in solutions of aliphatic nitrogen mustards have been found to be polarographically reducible in borate buffered solutions, pH 7.3. The $E_{0.5}$ values of the polarographic waves thus obtained vary with pH and concentration of the reducible species. The polarographic waves appear to be irreversible and a two electron reduction has been postulated. The velocity constants for the initial cyclization process of methyl-bis(β -chloroethyl)amine (0.124 min.⁻¹) and tris(β -chloroethyl)amine (0.311 min.⁻¹) have been determined polarographically, in borate buffered solutions, pH 7.3, at 25° C.

The thiosulfate substitution product (ET) resulting from the reactions of certain Dibenamine-like compounds with excess thiosulfate in 60 per cent ethanol, buffered with acetate at an apparent "pH" of 7.0, has been found to give well-defined polarographic waves upon reduction at the dropping mercury electrode. The diffusion current resulting from the reduction of the ET derivatives of Dibenamine and Dibenzyline was found to be proportional to the concentration of ET. The $E_{0.5}$ values of the ET polarographic waves vary with the concentration of ET. The waves are believed to be irreversible and a two electron reduction has been postulated. The velocity constants of the cyclization process of Dibenamine (0.00928 min. $^{-1}$), Dibenzyline (0.0214 min. $^{-1}$), N-(α -Naphthylmethyl)-N-ethyl- β -chloroethylamine (0.0144 min. $^{-1}$), and 1-Dibenzyl-amino-2-Chloropropane (0.00527 min. $^{-1}$) have been determined polarographically in 60 per cent ethanol solu-

tions of thiosulfate, buffered at an apparent "pH" of 7.0 with acetate.

A polarographic method is described for the determination of chloride ions, and sodium thiosulfate in 60 per cent ethanol.

Preliminary studies indicate that the thiosulfate substitution product of triethylene melamine is reducible at the dropping mercury electrode, and well-defined polarographic waves are obtained at various concentrations. The reducible species was analyzed in aqueous, acetate buffered solutions, pH 4.4.

Microfilm \$2.50; Xerox \$7.20. 152 pages.

SYNTHESIS OF DIAMINO DERIVATIVES OF DIPHENIC ACID

(L. C. Card No. Mic 59-6264)

Arnold Eugene Nicholson, Ph.D. Purdue University, 1956

Major Professor: Glenn L. Jenkins

Certain alkyl dialkylaminoalkyl esters of diphenic acid have recently been reported (1) to exhibit high antispasmodic activity. Esters of diphenic acid as well as diaminodiphenic acid also possess strong local anesthetic activity (2, 3).

Since the influence of amino groups on the physiological activity of certain other compounds has proven to be advantageous, this research was undertaken with the intention of preparing certain esters of diaminodiphenic acid so that the effect of the amino groups on the pharmacological activity could be studied. The esters which were studied were the dialkyl 4,4'-diaminodiphenate and alkyl dialkylaminoalkyl 5,5'-diaminodiphenate.

The dialkyl 4,4'-diaminodiphenates were prepared from the corresponding dinitro esters by a combined process of catalytic hydrogenation with platinum oxide and hydrazine hydrate and Raney nickel. The esters which were synthesized were made from n-propyl, iso-propyl, and n-butyl alcohol.

The half esters of 5,5'-dinitrodiphenic acid were prepared by refluxing the acid anhydride in absolute ethyl alcohol. The intermediate, ethyl 5,5'-dinitrodiphenoyl chloride, was synthesized by reacting the half ester with thionyl chloride. The resulting acid chloride was not isolated but instead reacted directly with the appropriate dialkylaminoalkyl alcohol to yield the split esters of 5,5-dinitrodiphenic acid. Since these compounds would not crystallize, their hydrochlorides were prepared. All attempts to reduce and isolate, as pure crystalline products, any of the split esters of 5,5'-diaminodiphenic acid were ineffectual. Utilizing the Parr hydrogenator the compounds were apparently reduced as indicated by the uptake of hydrogen. The solvent was ethyl alcohol, and platinum oxide was employed as the catalyst.

The following compounds not previously reported in the literature have been prepared:

Di-n-propyl 4,4'-Diaminodiphenate

Di-iso-propyl 4,4'-Diaminodiphenate

Di-n-butyl 4,4'-Diaminodiphenate

Ethyl Hydrogen 5,5'-Dinitrodiphenate

Ethyl 5,5'-Dinitrodiphenoyl Chloride

Ethyl 2-Diethylaminoethyl 5,5'-Dinitrodiphenate Hydrochloride

Ethyl 2-Dimethylamino-1-methylethyl 5,5'-Dinitro-diphenate Hydrochloride

Ethyl 3-Diethylaminopropyl 5,5'-Dinitrodiphenate Hydrochloride

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Microfilm \$2.50; Xerox \$4.20. 78 pages.

THE PREPARATION OF SOME 1-ALKYL- AND 1-ARYL-1,2,3,4-TETRAZOLE-5-THIOL AND 3-ALKYL- AND 3-ARYLTETRAHYDROQUINAZOLINE-2-THIOL COMPOUNDS AND THEIR INTERMEDIATES.

(L. C. Card No. Mic 60-1570)

Ronald Emerson Orth, Ph.D. State University of Iowa, 1960

Chairman: Professor James W. Jones

The most therapeutically active antithyroid drugs marketed today are those containing the thiourea moiety. It has been shown that for appreciable activity at least one of the nitrogens of this group has an attached hydrogen atom. Recent work leads to the belief that toxicity is reduced when the thiourea group is incorporated into certain ring systems. Methimazole, Carbimazole, and the thiouracils account for a great number of these ring compounds.

The methyl esters of N-substituted hydrogen, methyl, ethyl, n-propyl, isopropyl, n-butyl, cyclohexyl, benzyl, and phenyldithiocarbamate were prepared by dissolving the amine in aqueous sodium hydroxide, adding carbon disulfide dropwise under reflux with stirring, then the dropwise addition of methyl iodide. The pure products were obtained by fractional distillation after separation from the reaction mixture.

The 1-substituted hydrogen, methyl, ethyl, n-propyl, phenyl, benzyl, and cyclohexyl-1,2,3,4-tetrazole-5-thiols were prepared by refluxing the methyl dithiocarbamate esters in carbon disulfide.

 α -Bromo-o-nitrotoluene was prepared by the method of Kornblume. The α -bromo-o-nitrotoluene and a number of primary aliphatic amines were dissolved in ethanol and shaken together in sealed flasks. After standing one week, the solutions were filtered and evaporated to obtain the impure secondary amines. The higher boiling secondary aliphatic and the aromatic amines were obtained by re-

fluxing the bromo compound, primary amine and ethanol. The amines were characterized as the hydrochloride salts after purification. The amines prepared were N-substituted methyl-, ethyl-, n-propyl-, isopropyl-, allyl-, isobutyl-, t-butyl-, phenyl-, cyclohexyl- and benzyl-o-nitrobenzylamine.

The N-substituted-o-nitrobenzylamines were reduced to o-amino-N-hydrogen-, methyl-, n-propyl-, isobutyl-, allyl-, isopropyl-, benzyl-, cyclohyxyl- and phenylbenzyl-amine. They were characterized as dihydrochlorides.

The 3-hydrogen-, methyl-, ethyl-, isopropyl-, phenyl-, cyclohexyl-, and benzyltetrahydroquinazoline-2-thiols were prepared by refluxing the respective o-amino-N-substituted benzylamine in carbon disulfide, separation and purification. Microfilm \$2.50; Xerox \$3.00. 34 pages.

SOME STUDIES IN THIOPHENE CHEMISTRY

(L. C. Card No. Mic 60-1385)

Charles Howard Smith, Ph.D. The University of Mississippi, 1960

Chairman: Professor W. Lewis Nobles

The synthesis of certain 3-thenaldehyde derivatives, some of potential chemotherapeutic interest and others largely of theoretical interest, was investigated.

The preparation of a variety of 3-thiophene polyene compounds was attempted by means of base catalyzed aldol condensations. 3-Vinylthienyl 2-thienyl ketone and 3-vinylthienyl p-chlorophenyl ketone were synthesized and isolated. It was thought that the thiosemicarbazones might possess antitubercular activity. The only thiosemicarbazone possibly obtained was that of 3-vinylthienyl 2-thienyl ketone. The separation of the thiosemicarbazone from the recovered thiosemicarbazide was not adequate to afford an amount making analysis feasible; however, physical separation gave crystals to obtain a sharp melting point. The above ketones reported might possibly exhibit pharmacological activity. (The pharmacological results will be reported at a later date.)

Three new 2-aryl-4-metathiazones of possible central nervous system depressant activity: $3-n-amyl-2-(3-thienyl)-4-metathiazanone, 3-methyl-2-(3-thienyl)-4-metathiazanone, and 3-methyl-2-(5-chloro-2-thienyl)-4-metathiazanone were prepared by the condensation of <math>\beta$ -mercaptopropionic acid, monomethylamine or n-amylamine, and the required aldehyde.

In an effort to compare the reactivity of 3-thenaldehyde with that of 2-thenaldehyde, ω -nitro-3-vinylthiophene and 1-(3-thienyl)-2-nitropropene were prepared by the condensation of the aldehyde with nitromethane in one case and nitroethane in the second case using catalytic quantities of n-amylamine and employing no solvent as such. The 2-thenaldehyde derivatives previously prepared had a reaction period of two weeks. The two week reaction was satisfactory in the preparation of 1-(3-thienyl)-2-nitropropene, but 10-12 hours' reaction time sufficed for the preparation of ω -nitro-3-vinylthiophene, and charring occurred if the reaction was allowed to extend beyond the 10-12 hour period.

The Reformatsky reaction was shown to be applicable

to 3-thenaldehyde, and three new esters were synthesized, namely, ethyl β -(3-thienyl)- β -hydroxypropionate, ethyl α -methyl- β -(3-thienyl)-acrylate, and ethyl α -ethyl- β -(3-thienyl)acrylate. Saponification of ethyl α -methyl- β -(3-thienyl)acrylate yielded the free acrylic acid heretofore not mentioned in the literature.

The 3-thiophene isostere of 2-methyl-1-indanone, 5,6-dihydro-5-methyl-4H-cyclopenta[b]thiophene-4-one, was attempted via ring closure of the newly prepared 3-(2-methyl-2-propenoyl)thiophene by means of concentrated sulfuric acid. The reactants turned to a clear reddish color analogous to the description previously reported in the literature concerning the ring closure of α -methyl-2-acrylothienone. The amount of product obtained was too small to make purification feasible. The 2,4-dinitrophenylhydrazone was prepared and analysis indicated the formation of the desired ring compound. This compound has not previously been reported in the literature. Microfilm \$2.50; Xerox \$4.40. 81 pages.

CHEMISTRY, PHYSICAL

STUDIES OF SURFACE FILMS FORMED BY ADSORPTION OF POLAR ORGANIC MOLECULES ON ACTIVATED METAL SURFACES

(L. C. Card No. Mic 59-6278)

Roy Leo Bennett, Ph.D. The University of Tennessee, 1959

Major Professor: Hilton A. Smith

A study has been made of the adsorption of n-nonadecanoic acid on freshly machined metal surfaces. This is an extension of the work of Smith and Allen, McGill, and Fort. The machining techniques employed were the same as used by these workers and have been shown to produce an activated surface. Adsorption on solutionmachined cadmium and zinc reached saturation levels which corresponded to monolayers, if unit roughness were assumed. Tin did not attain full monolayer coverage. Desorption rate experiments on this metal show that the acid reacts to form the metallic soap which was rapidly desorbed into solution. As a result of this rapid desorption, complete coverage was not attained. Radiochemical exchange occurred in a pattern which would be expected if the entire surface were available for adsorption, not just that which was actually covered.

Titanium and vanadium also fail to adsorb full monolayers. However, in contrast to tin, desorption measurements fail to indicate the presence of detectable quantities of the metals in desorbing solutions. This indicated that the fraction of a monolayer on the surface was physically adsorbed. However, since the radiochemical exchange results showed that very little exchange occurred, there is the possibility that the adsorbed material was an essentially static chemisorbed partial monolayer.

The rates at which the metallic soaps desorb in n-nonadecanoic acid solutions have been investigated for tin, cadmium, titanium, and vanadium. Radiochemical

exchange of unlabeled molecules in the adsorbed films for labeled ones has been determined for these metals and also zinc. In each case where it was possible to calculate the rate constants for both processes, the rate of desorption was found to be faster than would have been predicted from the rate of exchange. This has been observed previously by Fort³ and was apparently due to the fact that the surface was not homogeneous, but certain portions or centers are more active than others.

Adsorption data of n-hexanoic acid, under the same conditions as employed with n-nonadecanoic acid, show that there is very little difference on a molar basis in the extent of adsorption with the two acids. This means that there was very little bridging over breaches on the surface which were much greater than the cross-sectional area of the carboxyl group. If this had occurred to a large extent with nonadecanoic acid, the short chain hexanoic acid would have fallen into these gaps, with higher adsorption resulting. This conclusion that the surface is relatively smooth is supported by evidence from electron photomicrographs and electron diffraction experiments.

Microfilm \$2.50; Xerox \$6.00. 123 pages.

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THE KINETICS AND MECHANISM OF THE IODINATION OF 2,4-DICHLOROPHENOL.

(L. C. Card No. Mic 60-1530)

Waldeen C. Buss, Ph.D. The University of Nebraska, 1960

Adviser: Jay E. Taylor

The kinetics of the reaction of 2,4-dichlorophenol with iodine in aqueous solution has been studied using a stirred flow reactor. The use of this technique has made it possible to measure the rate of the reaction under conditions which have been unattainable heretofore: at constant pH without added buffers, and at constant iodide ion concentration at low concentration of iodide.

A series of rate measurements were made in the pH range seven to eight without added buffers at 25° C. The iodide ion concentration was kept constant during these runs by adding excess iodide. It was found that the observed rate constants were inversely proportional to $([H^{+}] + K_{1})$ (where K_{1} is the ionization constant of 2,4-dichlorophenol) rather than inversely proportional to $[H^{+}]$ as previous workers have reported.

The effect of iodide ion concentration on the rate of reaction at 25° C. was studied with iodide concentrations near 10⁻³ molar. The pH was held constant during these

runs by means of a phosphate buffer. It was found that the observed second order rate constants were inversely proportional to $([I^-] + K_2)[I^-]$ (where $\underline{K_2}$ is the dissociation constant of the triiodide ion) rather than inversely proportional to $[I^-]^2$ as others have reported.

In the presence of phosphate buffers, the rate of reaction was found to be directly proportional to the concentra-

tion of HPO4=.

The effects of hydrogen ions, of iodide ions, and of basic species on the observed second order rate constants is expressed by the equation

$$k_{obs} = \frac{k_o + k_{cat}[base]}{([H^+] + K_1)([I^-] + K_2)[I^-]}$$

Three of the many mechanisms which have been proposed for this reaction can be shown to be in agreement with the observed results. These mechanisms are: (1) a mechanism in which the rate determining step is a reaction between hypoiodous acid and the phenol molecule, (2) a mechanism in which the rate determining step is a reaction between phenoxide ions and iodine cations, and (3) a mechanism in which the rate determining step is the departure of a proton from a quinoid intermediate which is assumed to be in equilibrium with iodine and phenol.

The ability of each of these mechanisms to explain the base catalysis and isotope effect which have been observed in this reaction, as well as their ability to account for the magnitude of the rate of reaction, are considered. On this basis, the latter of the three mechanisms appears preferable.

From the rates of reaction at 25° and 35° C., the activation energy, assuming the latter mechanism to be correct, is calculated to be approximately 10 kilocalories per mole.

Microfilm \$2.50; Xerox \$3.60. 64 pages.

TRANSFORMATION OF INORGANIC PHOSPHATES IN SOILS AS INFLUENCED BY pH

(L. C. Card No. Mic 60-1490)

Pa Ho Hsu, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Marion L. Jackson

The native inorganic phosphates of soil have previously been classified into calcium, aluminum, iron, and occluded phosphates. The first three forms are relatively more active than occluded phosphates in many chemical properties and thus are defined herein as "active inorganic phosphates." The purpose of this study was to investigate by means of solubility diagrams the chemical mechanism of transformation of phosphate of unweathered parent rock into other forms occurring in soils. The separation of aluminum phosphate from iron phosphate in the earlier fractionation procedure by Chang and Jackson was first subjected to a critical examination. The phosphates in eight soil profiles selected to represent varying drainage condition or degree of weathering were then fractionated.

The results may be summarized as follows:

First. The calcium, aluminum, and iron phosphates of soils are represented in the first approximation by hy-

droxyapatite, variscite, and strengite, their solubility products having been reported by various workers. The solubilities of these phosphates vary with the soil pH, but in different directions. Above 6.7, calcium phosphate is more stable than aluminum and iron phosphates, particularly in the presence of calcium carbonate. Below pH 6.7, aluminum phosphate and iron phosphate become more stable than calcium phosphate.

Second. The phosphate in calcareous soil horizons analyzed was mainly bonded to calcium. As the calcium carbonate leached out and the soil reaction dropped to below pH 6.7 during the process of soil development, calcium phosphate decreased while aluminum and iron phosphates concurrently increased. When a strongly acidic, highly weathered soil had been limed, the soil pH increased with a concurrent increase in calcium phosphate and decrease in aluminum phosphate and iron phosphate. These phenomena give evidence that the transformations of phosphate in soils are mainly controlled by pH.

Third. The plot of the percentage of active inorganic phosphate in the B and C horizons of soils against pH gave a smooth curve for each individual profile. The position of the curve shifted for different soils, all deviating from the equilibrium position. The back-transformation of aluminum and iron phosphates into calcium phosphate also deviated from equilibrium but in the opposite direction. Some aluminum and iron phosphates were found in slightly alkaline and even calcareous soils. Deviation from equilibrium can be interpreted by the heterogeneity of the soil within any horizon. The rate of phosphate transformation is controlled by the slow rate of diffusion of ions along moisture films joining particles of different species.

Fourth. The solubility diagrams for aluminum and iron phosphates indicate a large difference in solubility in fluoride solution, variable with pH, and a pH of minimum solubility for each of them. The solubility of iron phosphate is so low near the pH of the minimum solubility that it can be separated from aluminum phosphate in a fluoride solution of pH 8.2.

Fifth. The concentration of phosphate in the fluoride extract is controlled by the iron activity. Reprecipitation of the phosphate dissolved from aluminum phosphate is minimized by keeping the phosphate concentration sufficiently low. Soils of high iron activity generally have a low enough aluminum phosphate content to keep the concentration permissibly low. On the other hand, dissolution of soil iron phosphate, which resembles the "hot-precipitated" form, is minimized by limiting the time of extraction to one hour, in which time the aluminum phosphate is extracted completely.

The above conclusions indicate that the solubility product principle is helpful for investigation of the reactions involved in the phosphate transformations in soils and of the specificity of the separation of aluminum phosphate from iron phosphate.

Microfilm \$2.50; Xerox \$7.00. 150 pages.

DOUBLE LAYER STRUCTURE AND ELECTRODE PROCESSES

(L. C. Card No. Mic 60-1467)

Marcos Yusim Kleinerman, Ph.D. Louisiana State University, 1960

Supervisor: Professor Paul Delahay

The influence of the double layer structure on electrochemical kinetics is discussed for simple processes without specific adsorption and for processes with coupled chemical reaction. The influence of both the electrolyte concentration and the nature of the electrode is analyzed. Interpretation of processes without chemical reaction is based in two fundamental ideas (Frumkin): a) the double layer structure influences the effective difference of potential which favors the forward electrochemical reaction and hinders the backward reaction: b) because of electrostatic interactions the effective concentrations of reactants in the double layer are different from the bulk concentrations.

The influence of electrolyte concentration was studied for the reduction of iodate ions in alkaline solution on a dropping mercury electrode. The influence of the nature of the electrode was studied for the reduction of bromate ions in alkaline solution and the exchange current of the couple $Cr(CN)_6^{-3} + Cr(CN)_6^{-4}$ in cyanide solution at a dropping mercury electrode and three thallium amalgams of different thallium concentrations. The influence of the electrolyte and the nature of the electrode was considered in the reduction of chromate ion in alkaline solution. Agreement with theory is satisfactory.

Double layer effects for processes with a coupled chemical reaction are explained by variation of the concentration of reactants in the reaction layer. Approximate correction for this variation is possible with a simple treatment when the thickness of the reaction layer is small in comparison with that of the double layer. Results are given for the single pulse galvanostatic method. A more general treatment developed by Matsuda is applied to polarographic waves obtained in the discharge of cadmium cyanide complexes on mercury and three thallium amalgams of different thallium concentrations. Theory and experiment are only in qualitative agreement presumably because of the occurrence of more than one chemical step.

Implications of the very significant role of the double layer in electrochemical kinetics are discussed.

Microfilm \$2.50; Xerox \$3.80. 66 pages.

APPLICATION OF THE EFFECT OF VIBRATION-ROTATION INTERACTION TO THE DETERMINATION OF MOLECULAR FORCE FIELDS OF SYMMETRIC TOP MOLECULES

(L. C. Card No. Mic 60-1533)

Jack L. Koenig, Ph.D. The University of Nebraska, 1960

Adviser: Gordon A. Gallup

This study investigates the effect of some aspects of rotation-vibration interaction on the line strengths of the parallel bands of symmetric top molecules.

The Coriolis coupling interaction and the change in the moment of inertia with the vibration state of the molecule are investigated by quantum mechanical perturbation techniques. It has been found that the Coriolis coupling effect is zero to the first order of approximation, but that the change in moment of inertia introduces a change in the line strength proportional to $\delta_k^B(1-4\theta_k^B)$, where $\delta_k^B=4\pi B_0/\omega_k$, where B_0 is the rotation constant, and ω_k is the angular frequency of the kth normal coordinate, and $\theta_k^B=\mu_0\xi_k^B/\mu_{1k}$, where μ_0 is the static dipole moment and $\mu_{1k}=(\partial\overline{\mu}/\partial Q_k)_{Q_k=0}$, and ξ_k^B is the change in moment of inertia coefficient.

Experimental work reported here on NH₃ gives for $\xi_{|2}$ the value $0.14 \pm 0.05 \times 10^{20} \ gm^{-\frac{1}{2}} cm.^{-1}$ Using this value, and previous work on Coriolis coupling, the following valence field force constants were determined:

$$k_r = 6.994$$
 $k_{\alpha\alpha} = -0.053$ $k_{rr} = 0.122$ $k_{r\alpha} = -0.011$ $k'_{r\alpha} = 0.272$

All these force constants have units of millidynes/ Angstrom. Standard subscript notation has been used. Microfilm \$2.50; Xerox \$4.80. 93 pages.

SPECTROSCOPIC STUDIES OF
METAL-CYANIDE COMPLEXES:
PART I: INFRARED AND VISIBLE ABSORPTION
STUDIES OF CYANIDE COMPLEXES OF
Ni(II) IN AQUEOUS SOLUTION.
PART II: AN ANALYSIS OF THE INFRARED
VIBRATIONAL SPECTRA OF THE
TETRACYANONICKELATE(II) ION
IN THE SOLID STATE.

(L. C. Card No. Mic 60-1260)

Roy Lynn McCullough, Ph.D. The University of New Mexico, 1960

Part I

The infrared spectra of aqueous solutions containing tetracyanonickelate(II) and excess cyanide ions show a single new absorption peak characteristic of the pentacyanonickelate(II) ion, $[Ni(CN)_5]^{-3}$. The growth of this new infrared peak and the diminution of the known

 $[Ni(CN)_4]^{-2}$ peak is described completely by the equilibrium: $[Ni(CN)_4]^{-2} + CN^- = [Ni(CN)_5]^{-3}$ over a cyanide concentration range 0.05 - 5 M. No infrared absorption of a higher complex, e.g., $[Ni(CN)_6]^{-4}$ was detected even in nearly saturated NaCN and $\sim .4$ M $[Ni(CN)_4]^{-2}$. Infrared absorption characteristics of the complex ions are:

$$[Ni(CN)_4]^{-2}$$
, $\epsilon = 1068 \pm 95 \text{ mole}^{-1} \text{ liter cm}^{-1} \text{ at}$
 $2130 \pm 2 \text{ cm}^{-1}$
 $[Ni(CN)_5]^{-3}$, $\epsilon = 1730 \pm 230 \text{ mole}^{-1} \text{ liter cm}^{-1} \text{ at}$
 $2108 \pm 2 \text{ cm}^{-1}$

Continuous variation experiments at 100 Å intervals from 3800 Å to 6000 Å showed only a 1:1 complex between CN⁻ and [Ni(CN)₄]⁻². From visible and infrared absorption data the constant for the formation of [Ni(CN₅]⁻³ from [Ni(CN)₄]⁻² and CN⁻ was found to be 0.19 \pm 0.01 liters mole⁻¹ at 25.2° in solutions of constant ionic strength (μ = 1.34). The formation constant was determined at three temperatures over the range 15 - 35°, yielding a Δ H of ~ - 3 KCal/mole. Magnetic measurements show that the pentacyanonickelate(II) ion is diamagnetic.

Part II

An analysis of the symmetry of molecular crystals based upon the symmetry of the factor group is discussed. The relationships between the symmetry of the molecular group, the site group, and the factor group are considered, and from these considerations the unit cell symmetry coordinates are defined in terms of molecular symmetry coordinates.

The secular determinant generated from these unit cell symmetry coordinates is solved by a second order perturbation technique, and a relationship is obtained between the frequencies observed for molecules in a crystal lattice and their isolated molecular frequencies. Conditions under which these frequencies may be considered as equivalent are discussed.

Factor group analysis on the triclinic Na₂Ni(CN)₄·3H₂O crystals and the monoclinic BaNi(CN)₄·4H₂O crystals yielded two sets of selection rules; hence, a comparison of the polarized infrared spectra of single crystals of these two compounds served as an aid for the assignment of the frequencies of the tetracyanonickelate(II) ion. Interfering water vibrational frequencies were adequately distinguished by comparison with the spectra of the analogous compound Na₂Ni(CN)₄·3D₂O.

The observed crystal frequencies were assumed to be equivalent to the molecular frequencies. Employing a simplified quadratic valence force potential function, approximate force constants were calculated for the tetracyanonickelate(II) ion.

The second order perturbation solution of the secular determinant for the crystal was utilized in explaining the observed shift in the cyanide stretching frequencies for the compounds: Li₂Ni(CN)₄·3H₂O, Na₂Ni(CN)₄·3H₂O, K₂Ni(CN)₄·3H₂O, Rb₂Ni(CN)₄·3H₂O, and Cs₂Ni(CN)₄·3H₂O. Microfilm \$2.50; Xerox \$8.20. 178 pages.

ROTATIONAL ANALYSIS OF THE NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF PYRAZINE

(L. C. Card No. Mic 60-1390)

James Adrian Merritt, Ph.D. Vanderbilt University, 1960

Supervisor: Professor K. Keith Innes

This work contains the first analysis of the rotational fine structure of an ultraviolet spectrum of an aromatic molecule. The primary result of the work is precise information about the geometrical structure of pyrazine in two electronic states. In the case of pyrazine, which has no microwave spectrum and for which the infrared spectrum is quite complex, the ultraviolet spectrum is probably the most feasible, precise approach to the molecular structure of the ground electronic state.

In the attempt to obtain high resolution spectrograms of the rotational structure of the electronic absorption spectrum of pyrazine in the region 3200 A, the spectrum was photographed in the fourth order of a 150,000 -line, plane grating 3.4 meter spectrograph. The dispersion was 0.37 A/mm and the resolving power obtained was 125,000. Consistent with the identification of electronic transition with a nonbonding nitrogen electron the bands have the symmetrical appearance of infrared bands, indicating that the inertial constants are changed only slightly by the transition.

The rotational fine structures of twelve bands have been measured. The fine structure shows little dependence on the vibrations that are excited and the rotational analysis can therefore not be used as a positive method in identifying the vibrational numbers as is done with diatomic molecules. Rotational analysis of the fine structure shows the bands to be of the parallel type, that is the electronic transition moment is parallel to the axis of largest moment of inertia and perpendicular to the plane of the molecule. Strictly the bands are type C bands of an asymmetric top. The inertial constant determined from the spectrum is therefore the average of the two largest constants and the lack of other precise data prevents the determination of the parameters of the geometrical structure. The result for the ground state is $B_0 = \frac{h}{8\pi^2 C} \left[\frac{1}{I_A} + \frac{1}{I_B} \right] = 0.2048 \text{ cm}^{-1} \text{ which is con-}$

sistent with dimensions interpolated between those of pyridine and those of s-triazine, namely $^{\rm r}{\rm CN}=1.341~{\rm A},$ $^{\rm r}{\rm CC}=1.395~{\rm A},$ $^{\rm r}{\rm CH}=1.085~{\rm A},$ $^{\rm r}{\rm CNC}+116^{\circ}$ and $^{\rm r}{\rm CCN}=122^{\circ}$. The 0-0 transition is shown to be at $30875.79~{\rm cm}^{-1}$.

The analysis gives precise values for a number of the fundamental vibrational frequencies and supports identification of the bands with an allowed $^{1}B_{1u} - ^{1}A_{g}$ transition.

Microfilm \$2.50; Xerox \$5.00. 99 pages.

X-RAY DIFFRACTION STUDIES OF AQUEOUS SOLUTIONS OF HAFNYL AND ZIRCONYL HALIDES

(L. C. Card No. Mic 60-1445)

George Michael Muha, Ph.D. Rutgers University, 1960

Major Professor: Philip A. Vaughan

The angular dependence of the X-ray intensity scattered by aqueous solutions of HfOCl₂, HfOBr₂, ZrOCl₂ and ZrOBr₂ was measured for the concentration range 0.5 to 2.0 molal.

It was possible to separate the analysis of the experimental data into two parts, namely contributions from intramolecular distances giving rise to scattering at high angles and intermolecular contributions causing scattering in the small angle region. The small angle region lies below $\sin\theta/\lambda=0.15 A^{-1}$. In this expression, λ is the wave length of the incident radiation and 2θ is the scattering angle.

Radial distribution analysis was used to suggest possible molecular structures to account for the angular dependence in the large angle region $(\sin \theta/\lambda > 0.15A^{-1})$. The final structure was based on the result of a leastsquares fit of experimental and theoretical curves. These results indicate that the principle species in the hafnyl solutions was a complex [(Hf₄(OH)₈·16H₂O) X_n]⁺⁸⁻ⁿ in which the four hafnium atoms are arranged at the corners of a square linked together by oxygens. The chloride or bromide atoms (indicated by X) were found to be situated between the metal atoms above and below the plane of the square. The shortest Hf-Hf distance was found to be 3.57 Angstroms. The value of n could not be determined exactly. Very good agreement between theoretical and experimental curves could be obtained with 5 < n < 8.

The results for zirconyl solutions were less conclusive. A theoretical curve calculated with the least-square parameters found for the hafynl solutions showed fair agreement in the high angle region but considerable disagreement at low angles. These results indicate the possible presence of some other species in zirconyl halide solutions. Possibilities include a polymerization of the metal atoms to form a higher molecular weight species. Evidence for this type of polymerization is given by the results of the ultracentrifuge studies of Kraus and Johnson.¹

The intermolecular distances, which give rise to the small-angle scattering, were obtained by radial distribution analysis of the difference between the experimental data and the intramolecular contributions. The analysis was performed only for HfOCl₂ solutions. The results indicated an intermolecular distance between 18 and 26 Angstroms, depending on concentration. A logarithmic plot of distance versus concentration gave a slope of -0.32. This result is in excellent agreement with a model in which ions of the type found from the large-angle data are located on a semi-crystalline lattice in a cubic-closest-packed agreement.

Small-angle scattering data were also obtained for aqueous solutions of silico-tungstic acid. An analysis similar to the type used for the HfOCl₂ solutions failed

to give a good measure of the intermolecular distances involved. Microfilm \$2.50; Xerox \$4.60. 86 pages.

 Kraus, K. and Johnson, J., J. Am. Chem. Soc., 78, 3937 (1956).

THE BINDING OF SOME UNIVALENT CATIONS BY LONG-CHAIN POLYPHOSPHATES IN AQUEOUS SOLUTION

(L. C. Card No. Mic 60-1448)

Philip David Ross, Ph.D. Rutgers University, 1960

Major Professor: Ulrich P. Strauss

The association of alkali metal cations with long-chain polyphosphates has been studied in aqueous solutions maintained at constant total ionic strength with quaternary ammonium bromides. Usually, solutions maintained at 0.2 ionic strength with $(CH_3)_4$ NBr were investigated at 0.0° .

An electrophoresis method, based on an empirical calibration with completely bound counterions, has been developed to determine the fraction of PO₃⁻-groups neutralized by bound alkali metal ions. This association is found to obey the Law of Mass Action modified for the high electrostatic potential of the polyphosphate chain, for the interactions between neighboring PO₃⁻-groups and for changes in the molecular dimensions of the polymer.

The fact that the data may be successfully represented in such a manner provides strong evidence for binding occurring at specific sites along the polyphosphate chain. The binding follows the order of increasing crystal radii of the cations, namely, $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Cs}^+ \approx \text{TMA}^+$.

Systematic variations in the binding constants were attributed to a contraction of the polymer coil caused by increased binding and ion-multiple site interactions. This explanation was verified by viscosity studies on the same systems.

Attempts to utilize the viscosity data to obtain quantitative information about ion-multiple site interactions were handicapped by lack of an adequate theory relating molecular dimensions to the many factors involved in determining the size and shape of a polyelectrolyte molecule in solution. Qualitatively, the results indicate differences between the various cations with respect to this latter type of binding.

Membrane equilibrium studies gave binding results for Li⁺ and Na⁺ in good agreement with those obtained by electrophoresis, thus providing a check on both methods. However, in the case of K⁺ and Cs⁺ the dialysis method yielded much higher values for the degree of binding than did the electrophoresis technique. This discrepancy was attributed to a preferential concentration of the ion of smaller hydrated radius, in this case either K⁺ or Cs⁺, in the ionic atmosphere surrounding the polyphosphate chain.

The membrane equilibrium method detects these ions in the electrical double-layer, whereas electrophoresis gives a measure of bound ions in a region much closer to

the polymer chain, and thus does not detect this double-layer binding effect. In the case of Li⁺ and Na⁺ since they have the same hydrated radius as TMA⁺, no such effect would be expected, hence the two methods are in close agreement.

Except at very low concentrations of Li⁺ and Na⁺ where the extent of binding increased slightly with rising temperature, the results were identical at 5° and at 25°. This suggests that a favorable entropy change provides the driving force for the binding phenomenon.

The degree of binding was found to increase strongly with decreasing total ionic strength. This increase was ascribed to a decrease in the shielding effect of the ionic atmosphere, causing more neighboring PO₃⁻-groups to become effective in strengthening the binding of a cation by a given PO₃⁻-group.

Viscosity measurements on a single polymer sample in the same solvent systems used previously showed marked specific ion effects. It was shown that the intrinsic viscosity is not a unique function either of the degree of ionization of the polyphosphate or of the degree of binding of alkali metal ions. This result indicates the existence of specific solvent incompatibilities of site-bound ion-pairs.

Microfilm \$2.50; Xerox \$4.80. 94 pages.

X-RAY DIFFRACTION
AND OTHER STUDIES ON
THE SODIUM-OXYGEN SYSTEM AND
ON PERCHLORYL FLUORIDE

(L. C. Card No. Mic 60-1510)

Richard Louis Tallman, Ph.D. The University of Wisconsin, 1960

Supervisor: Associate Professor John L. Margrave

Single-crystal x-ray diffraction data show Na₂O₂-I (the room temperature polymorph of sodium peroxide) to be hexagonal, of Laue symmetry 6/mmm. The lattice dimensions, refined from powder diffraction data, are a = 6.207 \pm 0.004 A. and c = 4.471 \pm 0.003 A., in agreement, for Z = 3, with the roughly measured density. The estimated powder diffraction intensities agree with those calculated from the following positions:

Oxygen: $0,0, \pm p$; $1/3,2/3, \pm q$; $2/3,1/3, \pm q$; Sodium: r,0,1/2; 0,r,1/2; -r,-r,1/2; s,0,0; 0,s,0; -s,-s,0; where p=0.167, q=0.333, r=0.724, s=0.366.

The dimensions of the sodium and peroxide ions found in this structure are the same as those found in other compounds.

The possibilities of a sodium ion disorder and a peroxide ion disorder seem likely, but the theoretical effects of these disorders on the diffraction intensities were not found, even up to 500°C. Long range order there-

fore exists, but the development of domains unrelated by translation (twinning) cannot be eliminated experimentally.

The electron spin resonance (ESR) absorption spectra of sodium peroxide and sodium superoxide powder samples are very different from one another, indicating that a separate phase of sodium superoxide is not present in samples of sodium peroxide. This conclusion agrees with the x-ray powder diffraction results and with the thermodynamic calculations. Magnetic susceptibility, ESR, and oxygen evolution data are not inconsistent with the idea that sodium superoxide exists in solid solution in the sodium peroxide, as suggested by other workers. It is likely that the excess oxygen is the result of the presence of sodium ion vacancies, and that the yellow color (common to all sufficiently compacted samples) is that of superoxide ions created by the location of positive holes at peroxide ions of the lattice. This yellow color is whitened by cooling to liquid air temperatures, as is that of sodium superoxide. (The yellow color produced by breathing heavily on sodium peroxide does not whiten on cooling.) The blackening near the melting point remains unexplained.

A General Electric diffractometer equipped with a special furnace was used to record the powder diffraction pattern of Na_2O_2 -II at $550^{\circ}C$. The transition temperature was measured using the diffractometer; the more precise value from thermal analysis measurements is $512 \pm 1^{\circ}C$. Samples prepared by pouring molten sodium peroxide into liquid air give a powder diffraction pattern at room temperature which is tentatively identified as that of a third polymorph, Na_2O_2 -Q. The powder patterns of Na_2O_2 -II and Na_2O_2 -Q have not been indexed.

The thermal expansion coefficient of Na_2O_2 -I, from diffractometer data, was found to be isotropic and linear within the limit of error, and equal to $(2.84 \pm 0.4) \times 10^{-5}$ deg.⁻¹C (15 to 460°C).

The literature value, 675°C, is the best value of the melting point of Na₂O₂.

A North American Phillips 114.6 mm. powder camera was adapted for cooling of the sample by the flow of liquid air over the capillary, and used for a study of solid $C10_3$ F. The density, 2.18 ± 0.05 g./cc., and the powder diffraction pattern of $C10_3$ F at liquid air temperatures suggest that the $C10_3$ F structure is a pseudocubic (a = 5.38 A.) distortion of the cubic SiF₄ structure (a = 5.41 A.), with Z = 2 for both.

Microfilm \$4.05; Xerox \$14.20. 315 pages.

A VISCOSITY STUDY OF THE TRANSITION FROM POLYELECTROLYTE TO POLYSOAP

(L. C. Card No. Mic 60-1458)

Jacob Francis Woldering, Ph.D. Rutgers University, 1960

Major Professor: Ulrich P. Strauss

The transition from polyelectrolyte to polysoap was studied by viscosity measurements on compounds prepared by the complete quaternization of poly-4-vinylpyridine (P4VP) with varying amounts of n-dodecyl and ethyl bromides. Two samples of P4VP with molecular weights equal to 0.5 and 1.5 x 106 served as parent polymers for two series of such compounds. The values of S, the percentage of pyridine groups quaternized with n-dodecyl bromide, for these two series were 0, 6.8, 10.8, 12.1, 14.1, 16.5, 17.9, 19.8, 21.5, 22.4, 31.9, and 0, 4.6, 7.2, 10.5, 13.5, 26.5, respectively. Light-scattering results indicated that the molecular weights of the compounds in the series prepared from the lower molecular weight P4VP were close to the expected values. However, the compounds derived from the other P4VP sample, with the exception of the polyelectrolyte, had suffered a decrease in molecular weight, in one case amounting to almost 50%. Intrinsic viscosities, $[\eta]$, and Huggins' constants, k', were determined in 0.023 and 0.18N aqueous KBr at 25° and 45° C. The intrinsic viscosity decreased

monotonically over the entire range of S values, the decrease being more rapid in the region of lower S values. The steepest drop took place in an S region from about 7 to 13.5 in 0.023N KBr and from 0 to about 10 in 0.18N KBr for both series. In general, the over-all decrease in $[\eta]$ under a given set of conditions was one order of magnitude. This contrasts with a decrease of two orders of magnitude found by Gershfeld. Values of $[\eta]$ were found to increase with an increase in molecular weight and to decrease with an increase in ionic strength. All three of these effects were most pronounced in the S region from 0 to 13.5.

The values of Huggins' constant, k', were unusually large and showed maxima in the S region from 10 to 13.5 in agreement with previous results. Values of k' increased with an increase in ionic strength and decreased with an increase in temperature. No trend with change in molecular weight was evident.

For polysoaps with S greater than 15, the observed values of the intrinsic viscosity were of the same order of magnitude as the hypothetical values expected in a theta solvent. This finding contrasts sharply with Gershfeld's whose polysoaps had intrinsic viscosities an order of magnitude lower than their calculated theta solvent values. This disparity, which indicates that the polysoap molecules encountered in the present investigation did not attain the extreme degree of compactness exhibited by Gershfeld's polysoaps, may be due to structural differences in the respective parent polymers.

Microfilm \$2.50; Xerox \$6.00. 121 pages.

ECONOMICS

ECONOMICS, GENERAL

LOCAL INCOME TAXATION: CITY AND COUNTY OF DENVER AS A CASE STUDY.

(L. C. Card No. Mic 58-1206)

Robert Leland Darcy, Ph.D. University of Colorado, 1957

Supervisor: Professor Earl C. Crockett

The city and county of Denver is representative of many large municipalities in the United States which find themselves in need of additional tax revenues to support greatly expanded budgets. One highly productive non-property tax measure that has received attention in Denver (as well as in local governmental units in 24 other states) is the income tax, used with apparent success by the city of Philadelphia since 1939 and currently employed by more than 450 minor jurisdictions in five states. The question examined in this thesis is: how well does the local income tax meet the tests of a good revenue measure?

A survey of the development and current use of local income taxation in the United States discloses six distinctive forms of local income taxation, although all have at least three features in common: (1) some form of income is used as the tax base; (2) a low, flat-percentage-rate is applied; and (3) taxes are withheld on wage-earners. The major variations between forms involve the definition of the tax base. The Toledo form, which has been suggested for Denver, defines the tax base broadly to include the gross earnings and net profits of all residents, gross earnings of nonresidents attributable to Toledo, and the net profits attributable to Toledo of all incorporated and unincorporated businesses operating in the city.

A principal contribution of the thesis is the selection of important criteria of local taxation and the construction of a frame-work for evaluating the local income tax. Analysis of the tax as it would operate in Denver discloses the following findings. A tax of one per cent on gross earnings and net profits would yield approximately 10 million dollars, of which 1.5 million would be contributed by wageearners employed in Denver but living outside the city. The tax could be administered effectively at an approximate cost of \$350,000, or 3.5 per cent of collections. Almost without exception, the incidence of the tax would be on wage-earners and the owners of business firms. The effective rate structure of the tax on individuals would be proportional in the lower income range and (because of the exclusion of property income and deductibility feature of federal and state income taxes) regressive in the middle and upper ranges. Apart from a potential problem of intergovernmental relations, no major economic, political, or social effects (either salutary or injurious) would be likely to result from the income tax. The most serious criticism that can be made of the Denver-type income tax is that apparently it fails to meet the community's

standards of equity The rationality of the tax is questionable, its burden is regressive, no personal exemptions are allowed, and the tax discriminates against income earned from personal effort. Similar criticism can be made of most of the taxes presently used by local governmental units.

In its suggested form, the income tax is neither the best nor the worst revenue alternative that might be adopted. There is no compelling reason, however, why consideration of an income tax should be limited to this traditional, gross earnings form. The major weaknesses of the tax could be eliminated by adopting a levy that allowed personal exemptions and added property income to the base. Refinements of this type would entail additional costs of collection, however, and the exemption feature would reduce collections from the tax. Such conflicts make it necessary to choose and compromise in formulating local tax policy. The contribution of this dissertation consists of providing the means for reaching an intelligent decision on the proposal by clarifying basic issues, ascertaining pertinent factual information, and emphasizing the need for and crucial role of value judgments.

Microfilm \$4.35; Xerox \$15.30. 339 pages.

JOHN R. COMMONS, INSTITUTIONAL ECONOMIST.

(L. C. Card No. Mic 60-1361)

Lafayette George Harter Jr., Ph.D. Stanford University, 1960

The career and accomplishments of the economist, John R. Commons, registered the progress of the breakdown of the nineteenth century concepts of laissez-faire individualistic economics. He was a university professor and a prolific writer, but above all, he was a reformer advocating greater security and welfare for the workers of the nation.

In his early years as a teacher, his propensity to participate in numerous reform activities brought him into conflict with university authorities. Finally, when his chair at the University of Syracuse was abolished, he spent five years outside the teaching profession. During this time his position as a researcher for the United States Industrial Commission and a labor conciliator for the National Civic Federation provided him with an opportunity to study the labor movement. On the basis of this experience he was called to the University of Wisconsin by Richard T. Ely to work on a history of labor which became a classic in the field.

At the University of Wisconsin Commons allied himself with Robert M. LaFollette and the Progressives. He served a term as a member of Wisconsin's Industrial Commission, as a commissioner on the United States Commission on Industrial Relations, and as an advisor for various governmental agencies. More important, he drafted a number of bills which were adopted as laws. Among these the laws on the regulation of public utilities, workmen's compensation, industrial safety, minimum wage laws, and unemployment compensation became models which other states followed closely. The significance of these laws lies not only in the individual reforms toward which they were directed, but in the fact that when shown in sequence, they measure progress away from laissezfaire individualism along the road to the welfare state.

As a teacher, Commons was one of America's greatest. He was not a brilliant lecturer, but he could inspire and develop his students as well as earn their respect and devotion. Many of them earned chairs at leading universities while others staffed government agencies or became outstanding administrators. Like Commons, many of them were important reformers. Much of what he accomplished was possible only because of their co-operation.

Commons as a scholar, received his greatest recognition as an authority on labor. His conceptions were compatible with those of labor leaders, including Samuel Gompers, and they were widely accepted by most students of the labor movement.

In other fields of economics his theories have not been enthusiastically received. His economics was classified under the broad category of Institutional Economics, which meant chiefly that it could be construed as a protest against more orthodox economics. However, Commons considered his theories as supplements rather than refutations to the usual economics. He explored the mechanisms by which society by the use of economic transactions evolved from one stage to the next. He was particularly interested in what might be done to develop economic institutions which would bring greater security and welfare to the people. His thought was deeply embedded in philosophy, psychology, ethics, and legal conceptions. Because he invaded the territory of so many disciplines and because his exposition lacked clarity, his work was not easy reading. It has been neglected by most economists.

Commons wanted to change economic thinking in America. His theories failed to do this, but the reforms in which he had significant roles did exactly this.

Microfilm \$4.65; Xerox \$16.45. 363 pages.

UNITED STATES IMPORT RESTRICTIONS AND AMERICAN AGRICULTURE

(L. C. Card No. Mic 60-1468)

Hugh E. Law, Ph.D. Louisiana State University, 1960

Supervisor: Visiting Professor Hubert E. Bice

Domestic agricultural policy appears to have been formulated with little regard for the foreign trade objectives advocated by the United States since the passage of the Reciprocal Trade Agreements Acts. This study is an attempt to analyze the effects that foreign trade and agricultural policy decisions, often at cross purposes, have had on resource utilization by American agriculture.

Authoritative works in the fields of foreign trade policy and agricultural policy were used as the sources for most basic ideas. Congressional hearings, and government publications and statistics were used to supplement the works cited above in showing the effects of past policy decisions on various selected agricultural commodities and their production. A short inquiry was made into the reasons for, and benefits accruing from trade between this nation and others. Import restrictions that tend to lessen movements of goods and services were examined to see what effect they had on the economy and upon the producers of agricultural commodities. The use of resources in the production of various commodities was examined in order to determine how the efficiency of their use was affected by the contraction or expansion of American imports.

It was determined that agricultural policy should be more closely coordinated with foreign trade objectives to further international relations. In addition, farm policy which is often incompatible with the best interests of international relations, in many cases, is also incompatible with the best interests of American agriculture. It was established that the "farm bloc" has often aided in the passage of legislation which aids very few farmers and which may impose a burden on the entire economy. In addition it was discovered that much of the latest agricultural legislation and policies have not been helpful in solving the real farm problem-excessive numbers of low income farmers. It was established that the attempts made to increase the level of farm income with price support programs often give little if any help to low income farmers. Nevertheless, such programs have restricted normal exports and led to "dumping." In addition these price support programs have increased the need for import restrictions and have tended to slow up the normal pattern of resource

It is concluded that a re-orientation of agricultural policy should be forthcoming. Resources should be aided in their shift to more efficient and better paying pursuits. Potential importers should be encouraged, not hampered. Agricultural producers unable to cope with imports should be aided in shifting resources to the production of other commodities or other industries. The program should presume that benefits accruing to the economy should not be paid by the producers feeling the brunt of competition from increased imports. For this reason the cost of reorientation should be born by society and the time needed to accomplish the shift should be long enough to permit a smooth period of transition. To assist in accomplishing this shift the economy needs to be kept a full or near full employment.

Microfilm \$2.85; Xerox \$9.90. 218 pages.

THE CANADIAN DOLLAR, 1948-1957.

(L. C. Card No. Mic 59-5244)

G. Paul Wonnacott, Ph.D. Princeton University, 1959

In early October, 1950, the Canadian Government abandoned the system of pegged exchange rates and allowed market forces to determine the value of the Canadian dollar on the international exchanges with only limited official intervention. The aims of this dissertation were to investigate the events which preceded this policy shift, to consider the factors which have made the Canadian experiment

with a flexible exchange rate relatively successful, and to study the activity of the Canadian Exchange Fund Account.

In the early postwar period, the official par of the Canadian dollar was changed twice. The 1946 revaluation of the Canadian dollar from its wartime discount of approximately 10% to equality with its American counterpart was aimed not at solving any fundamental disequilibrium in Canada's international accounts, but rather was intended to mitigate inflationary pressures in the Canadian economy. This revaluation was followed in 1947 by an alarming drain on Canadian reserves of foreign exchange which was due, however, to triangular imbalance in Canada's international accounts rather than to an over-all weakness of her international position. Devaluation was therefore passed over in favor of import regulations as a means of checking the drain on reserves, which recovered from less than \$500 million (U.S.) near the end of 1947 to over \$1,000 million (U. S.) by early 1949. However, because Canada feared exchange pressures as a result of the devaluation of the pound in September, 1949, she quickly followed suit with a devaluation of approximately 10%.

Within a year, the conviction that the Canadian dollar was pegged too low became so widespread that there was a veritable flood of speculative capital into Canada, which greatly complicated the problem of inflationary pressures created by the Korean War. Largely because of the repeated failure to choose an appropriate lasting fixed rate, the Canadian Government decided to allow the rate to fluctuate.

Long-term capital inflows have been a major disturbing factor in the Canadian accounts since 1950. In spite of the unfavorable balances on current account, the Canadian dollar has moved upward on the international exchanges over the period 1950-57. The anti-inflationary effect of such an upward movement has on the whole been welcome during a period when inflationary pressures were pushing up the price level, and one of the major potential dangers of flexible exchanges, namely, a price-wage-exchange spiral, has not been a significant factor in Canada.

On the whole, short-term capital movements between Canada and other countries have been stabilizing in nature since 1950. However, a number of special circumstances inspired the confidence in Canadian exchange stability which was an important factor in the stabilizing movements of capital. Canada followed relatively conservative fiscal policies. Canadian monetary policy was relatively restrained, with the result that inflation in Canada was not appreciably more rapid than inflation in the United States in spite of the Canadian investment boom. Canada had a history of exchange rate stability and the belief was firmly ingrained in Canadian thinking that the rate of \$1.00 Canadian: \$1.00 U.S. was in some sense "normal."

The Exchange Fund Account has since 1950 engaged in limited activity to stabilize the short-term movements of the exchange rate. Because of the importance of maintaining the tradition of exchange rate stability, further Exchange Fund Activity to moderate the rate fluctuations would be desirable, particularly during extended periods of exchange rate movement in one direction.

Microfilm \$4.05; Xerox \$14.20. 314 pages.

ECONOMICS, AGRICULTURAL

INFLUENCE OF FEDERAL ACREAGE CONTROLS ON COSTS AND PRODUCTION PRACTICES FOR TOBACCO

(L. C. Card No. Mic 60-1296)

Loyal Merlyn Hartman, Ph.D. North Carolina State College, 1960

Supervisor: George Stanford Tolley

The purpose of this study is to estimate the effect of the Federal Program on production practices and costs in flue-cured tobacco production. It is assumed that, since the land input is restricted, the nature of program effects to be expected are land-saving changes in practices. The approach used to test for this effect is to estimate input use for alternative production practices and compute costs for these several alternatives using estimated costs of land with and without acreage controls. A comparison of these costs indicates if there would be incentives for producers to change practices if controls were removed. The results help to answer the question, does the use of acreage restrictions in controlling production alter input proportions? The results also help to estimate the effect of acreage restrictions on costs of production and on the longrun equilibrium price of tobacco without the program.

The major empirical problem in the study is to estimate how inputs and output vary for the alternative practices. The approach is to predict yield per acre and labor use per acre for alternative production practices. The practices of major interest are levels of nitrogen and plants per acre. It is assumed that other changes in practices that have occurred since inception of the program either were not related to the program or would be irreversible, e.g., new varieties may have been developed in response to the program, but these would still be available if acreage controls were removed. The effects on yields for nitrogen and plants per acre are established from experimental data. In addition, a labor requirements relation is derived from survey data to provide estimates of labor hours for each of the alternative practices.

The yield predicting relation is related to the historical change in yield to see if increases in yield which have actually occurred are explainable in terms of the production practice changes being considered. Variance estimates of inputs and yields are introduced into this analysis to test the statistical reliability of the results. The relation appears successful in explaining historical changes in yield at usual significance levels.

Production cost comparisons for different numbers of plants per acre and levels of nitrogen application lead to the conclusion that use of present levels for these practices reduces costs measurably over historical levels. Using an estimated land cost without the program the present levels of nitrogen result in a lower cost than the historical nitrogen levels, although the differences in costs between different application of nitrogen were of small magnitude. The smaller number of plants per acre resulted in lower costs using a land cost without acreage restrictions. These results indicate that removal of acreage restrictions might effect the number of plants per acre but not use of nitrogen.

The conclusions of the analysis stand up well in the face of tests against (1) considerations from production theory and (2) sampling and other variability on the data.

The estimated reduction in costs per pound of tobacco with removal of controls is in the neighborhood of ten cents per pound. This reduction in cost occurs because of the change in the land cost with lifting of the land restriction. The reduction in cost of ten cents per pound from the present market price of tobacco also gives an estimate of the long-run equilibrium price without the program. In interpreting the results of the study, it should be kept in mind that owners and renters of land would be affected differently by changes in the tobacco program.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

CHOICE OF OPTIMUM RATES OF NITROGEN FERTILIZATION FOR CORN ON NORFOLK-LIKE SOIL IN THE COASTAL PLAIN OF NORTH CAROLINA

(L. C. Card No. Mic 60-1297)

Joseph Havlicek, Jr., Ph.D. North Carolina State College, 1960

Supervisor: Charles Edwin Bishop

The objectives of this study were: (1) to appraise yield response equations for Norfolk-like soil as a basis for nitrogen fertilizer recommendations, (2) to determine optimum levels of nitrogen for selected price, soil, and weather conditions, (3) to appraise the costs involved in not knowing the specific values of prices and physical factors that affect optimum levels of nitrogen, and (4) to analyze the choice of nitrogen level in view of a probability distribution of drought indices obtained from past weather data.

The static theory of the firm was used in the economic analysis, and some of the restrictive assumptions were relaxed so that alternative prices, alternative physical conditions, and capital restrictions could be analyzed. The "cost of making the wrong decision" was used to analyze variables about which farmers are uncertain. A strategy matrix was used to examine alternative methods of choosing the level of nitrogen fertilization in view of weather uncertainty.

The study was based on data for 37 field experiments conducted on Norfolk-like soil during 1955, 1956, and 1957. The Norfolk-like soils frequently have high levels of residual phosphorus and potassium, and corn showed little response to added phosphorus and potassium. Quadratic response equations, fitted to the data for each location, that contained only nitrogen as an independent variable accounted for nearly as much variation in corn yield as did quadratic response equations which contained phosphorus and potassium also.

Since variation in soil characteristics and weather conditions could not be accounted for by response functions fitted to data of individual locations, a general response equation provided the basis for the economic analysis. The general response equation expressed corn yield as a function of organic matter, pH level, drought indices, and applied nitrogen.

The per cent of organic matter and pH level of the soil did not affect the choice of an optimum level of nitrogen; however, both affected corn yield and net revenue. For the observed ranges of organic matter and pH level, 5.71 bushels per acre was the maximum amount that either affected yield.

Three widely different input-output price ratios were used to investigate the importance of knowing the input-output price ratio in choosing an optimum level of nitrogen. For nitrogen levels of 125-180 pounds per acre, the costs of making the wrong decision about the input-output price ratio were relatively small. For levels considerably below this range, applying nitrogen on the basis of the input-output price ratio was more important.

The costs of making the wrong decision about weather conditions were quite large if nitrogen was applied for a weather condition widely different from the prevailing one. Using the strategy matrix, the choice of an optimum nitrogen level was analyzed for four selected choice criteria. The optimum levels for the four criteria were approximately the same, about 180 pounds per acre for farmers with no capital limitation and on Norfolk-like soils with relatively high levels of residual phosphorus and potassium.

The relationship between marginal expected net revenue and applied nitrogen was linear. The net revenue per additional dollar invested in nitrogen was relatively high even for levels of nitrogen that differed only slightly from the optimum level. Farmers who have access to additional capital can afford to pay a relatively high rate of interest for borrowed capital in order to apply a level of nitrogen that is very near the optimum level. If additional capital cannot be obtained, the farmer will forego the marginal expected net revenue that additional capital would yield; however, restrictions of 30 pounds or less per acre below the optimum level do not critically affect expected net revenue.

Microfilm \$2.50; Xerox \$6.20. 130 pages.

A SPATIAL AND SEASONAL ANALYSIS OF CORN PRICES IN NORTH CAROLINA

(L. C. Card No. Mic 60-1302)

Travis Denton Phillips, Ph.D. North Carolina State College, 1960

Supervisor: Richard Adams King

The purpose of this study was to analyze prices in North Carolina corn markets in order to gain information necessary for understanding the spatial and temporal behavior of prices. Using theoretical price differentials between prices in North Carolina and in other markets, price limits for 1953-54 through 1957-58 were developed within which prices in the markets being studied were expected to fall. In making these estimates, intermarket movements of corn were studied during a two-month period at harvest time and a later two-month post-harvest period.

Using production, utilization, storage relationships, and marketing practices, three distinct marketing areas were delineated. The northeastern Coastal Plain is a cash corn area which has little off-farm storage capacity for corn. Considerably more storage is performed in the central Coastal Plain. The Piedmont is a deficit corn producing area where marketing facilities consist largely of feed manufacturing facilities.

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The perfect market concept was used as a bench mark for developing hypotheses describing the expected behavior of prices in selected North Carolina markets. The information used to delineate areas was used to develop theoretical price limits for each market and to develop hypotheses of how the marketing structure was expected to operate. Out-of-state shipping destinations for surplus Coastal Plain corn were Norfolk, Baltimore, and Harrisonburg. Cincinnati was used as a pricing point to represent corn coming from the Midwest.

Theoretical price limits were developed by adding transfer costs to prices in markets from which purchases were made and subtracting transfer costs from prices in markets to which corn was shipped. Prices paid local producers at each North Carolina pricing point were compared with the theoretical price limits for each market. Although observed prices generally conformed to the theoretical price limits, individual weekly prices often fluc-

tuated around the price limits.

Several problems confronting individuals in corn production and trade come to light from the price analyses. Prices received by corn dealers shipping surplus corn from the Coastal Plain are not always reflected in the prices paid producers. Forces outside the North Carolina marketing area cause seasonal prices to be quite unpredictable, making storage decisions very difficult. At harvest the spreading of corn shipments from the Coastal Plain to the Piedmont over a few more weeks would depress prices less relative to the Midwest. Additional information, especially on the adequacy of present facilities, is needed to supplement the price analyses in order to draw firmer conclusions regarding the best methods for improving marketing efficiency.

Microfilm \$2.50; Xerox \$7.00. 150 pages.

INSTITUTIONAL CREDIT AND THE EFFICIENCY OF SELECTED DAIRY-FARMS

(L. C. Card No. Mic 60-553)

Gerald Ion Trant, Ph.D. Michigan State University, 1959

The purpose of this study was to appraise the adjustment possibilities facing selected dairy farms within the credit restrictions imposed by formal credit institutions.

It was believed that such an appraisal of adjustment possibilities would serve as a useful basis for delineating and evaluating problem areas in a rapidly changing segment of Michigan Agriculture.

Criteria of efficiency suitable to use with both intrafunctional and inter-functional types of adjustment were developed. These economic criteria were presented in conjunction with ethical criteria, that the author considered relevant in appraising the possible adjustments of the studied farms.

Intra-functional adjustment possibilities for the studied farms were explored in conjunction with a statistically fitted production function of the "Cobb-Douglas" type. It was found that more efficient adjustment on the statistically estimated production function, would force the farms out of dairying and organize them as fairly typical cash crop enterprises.

More efficient adjustments for the studied farms, that would maintain them as dairy enterprises were indicated to be possible, if the farms were to be shifted to a new labor efficient production function. In this instance budgeting was the technique used to make the hypothetical adjustment on the individual farms. The coefficients in the modified budgets subsumed a labor efficient technology.

The tentative results of the study were as follows:

1. Enough credit was available from institutions to permit more efficient adjustment of the studied farms, and at the same time maintain them as dairy enterprises.

2. Labor saving technology was required to make the farms both more efficient, and at the same time continue them as dairy enterprises.

3. Earnings of labor and income levels were found to be low, relative to wage rates of industry.

4. The budgeted adjustments on the studied farms implied large increases in milk production, even with land and labor fixed at their initial levels.

5. If the milk production increases implied in the modified budgets are generalized for a large segment of the Detroit milk shed, important reductions in milk prices, and hence in efficiency are implied.

6. Inadequate communications between lenders and borrowers have resulted in credit problem situations for

many farm borrowers.

In the light of these results, it was concluded that the consequences of generalized increases in efficiency in the dairy industry, that involved shifting to the production function assumed in the modified budgets, would tend to be self defeating, unless control of production were also to be established. Consequently, in the recommendations, a hypothetical program was formulated that would appear to result in the joint attainment of increased efficiency, and equality of treatment for farm operators, in the dairy industry.

Microfilm \$2.55; Xerox \$8.80. 193 pages.

ECONOMICS, COMMERCE - BUSINESS

THE GROWTH OF THE MARKET-ORIENTED ECONOMY IN NORTHERN RHODESIA, 1945-1955.

(L. C. Card No. Mic 59-6295)

Mahlon Carl Brown, D.S.S. Syracuse University, 1959

Supervisor: H. V. B. Kline, Jr.

The process of market widening in Northern Rhodesia in the period of 1945-1955 is examined in this study. Market growth in Northern Rhodesia reflects and is complicated by the cultural differences which exist between Africans and Europeans. The study treats three systems of collecting and distributing goods and services which exist in the Territory.

The methods of distributing goods and services practiced by rural Africans are examined first. A description and analysis of the European rural and urban market

system follows. The urban African market system is then examined, followed by an analysis of market growth as it relates to the Ten-Year Plan and to economic development.

The study shows that some instances of market growth in Northern Rhodesia are in effect microcosmic cases of economic development. The study shows too, that market growth in Northern Rhodesia came as a consequence of the development of mining and related industries. It is also shown that the market growth which has occurred in the period since World War II has provided a stimulus for the expansion of a small manufacturing industry.

It is pointed out in the study that capital for developing the mining industry has been fairly easy to get. It is suggested that since World War II, capital has been more readily available for secondary industries in the Territory where there has been a market for their product. The really difficult problem in Northern Rhodesia is that of channeling capital into the underdeveloped African sector in order to promote effective economic growth. It will be seen in the study that the methods of promoting African development may result in the same kinds of problems of surplus agricultural production which plague other major world producers of agricultural commodities. It is shown too, that the present course of action appears to be leading toward the same kinds of class conflict (complicated by racial factors) that have troubled many of the more highly developed countries of Europe.

It is clear that the market serves as a major force for the promotion of culture change among Africans in Northern Rhodesia. It is also clear that the effectiveness of the market is reduced by such hampering factors as (1) the low level of the African's technological development, (2) the continuing influence of inappropriate cultural traits, (3) the low level of economic development which already exists in the African sector, and (4) the factors of racial conflict.

Microfilm \$3.60; Xerox \$12.20. 280 pages.

A STUDY OF THE EFFECT OF THE ROBINSON-PATMAN ACT UPON COOPERATIVE ADVERTISING POLICIES AND PRACTICES

(L. C. Card No. Mic 60-1175)

John Robert Davidson, Ph.D. The Ohio State University, 1959

In 1961 the Robinson-Patman Act will have been in effect for twenty-five years. Dealing as it does with price discrimination, generally, and with pseudo brokerage charges and disproportionate cooperative advertising services and allowances, specifically, it was thought that sufficient time had elapsed to permit an appraisal of the Act in terms of its effect upon cooperative advertising policy and practice. With this general purpose in mind, the following specific areas were investigated:

- 1. The effect of administrative and judicial interpretation upon policy and practice
- 2. Use of cooperative advertising as a promotional tool
- 3. Surveillance and enforcement activities by the Federal Trade Commission

4. Attitudes of users of cooperative advertising toward the Act and the Commission

A review of the provisions of the Act as interpreted by the Federal Trade Commission and by the courts revealed that--

- 1. Standards have been established by the Commission for applying the proportionally equal terms provision of the Act. Questions of the intent of Congress have been administratively and judicially resolved;
- 2. Court action in the Automatic Canteen case has had the effect of negating buyer responsibility for inducing illegal cooperative advertising allowances and services.

A comparison of the policies and practices with regard to cooperative advertising before and immediately following passage of the Act with those of today showed that--

- Abuses on the part of chain stores encouraged passage of the Act;
- Uncertainty and doubt caused unnecessary discontinuation of use of this promotional tool;
- 3. Present-day competitive conditions continue to require cooperative advertising where sales strategy calls for selective distribution;
- 4. Abuses growing out of deficiencies in administrative policies and procedure abound in certain industries, abetted by loose practices by certain media. In spite of such abuses, approximately 20 per cent of national expenditures for advertising are allocated to cooperative advertising;
- 5. Internal policing by trade associations of manufacturers, dealers, and media give promise of reducing disadvantages inherent in present-day policies and practices.

The effect of surveillance and enforcement policies of the Commission has been to encourage voluntary compliance and at the same time to serve notice that no segment of the consumer-goods manufacturing and distributing industries is exempt from its scrutiny. Furthermore, its compliance procedures ensure the continuation of periodic surveillance. Reorganization of the Commission's staff and procedures now permits the handling of dockets more speedily and efficiently.

Semi-directed interviews with businessmen who deal with cooperative advertising revealed that--

- 1. They view cooperative advertising as a promotional tool with divergence of opinions;
- There is a paucity of knowledge and much misunderstanding about the provisions of the Act and the functions of the Commission;
- 3. Ignorance of the prohibitions of the Act and how it has been enforced tends to create a sense of false security. Despite frequently occurring articles in the trade press, there is need for greater dissemination of information regarding the Act and the current activities of the Commission.

Enforcement over nearly twenty-four years has served thus far to justify the faith initially placed in the Act by its sponsors. It has had a salutory effect in reducing the dangers of competitive abuses in our economy. Its language has permitted interpretation and application to changing competitive conditions. Present interpretation exercises a deterrent effect upon the use of cooperative advertising. The Commission's enforcement policy and the promulgation of trade practice rules exert a wholesome

influence upon present-day users, thereby enhancing the favor and trust with which vertical cooperative advertising practices are viewed. The solution of problems of present-day abuses lies! the use of effective administrative procedures.

The findings of this study place the Robinson-Patman Act and the Federal Trade Commission in a favorable and constructive light.

Microfilm \$4.75; Xerox \$16.90. 372 pages.

ACCOUNTING AND FINANCING FEATURES OF SELECTED QUALIFIED DEFERRED COMPENSATION PLANS

(L. C. Card No. Mic 60-1463)

George Watson Fair, Ph.D. Louisiana State University, 1960

Supervisor: Professor Robert H. Van Voorhis

The 1954 Internal Revenue Code contains the requirements for qualifying employee benefit plans of the deferred compensation type. Earlier legislation on the subject of pension and profit sharing has been revised in order to bring as much standardization and non-discrimination as is possible into the governing regulations. Enough time has elapsed since the enactment of the provisions of the Code, permitting favorable tax treatment of employer contributions to the trust and the earnings therefrom, to appraise the immediate and future effects. Both direct and indirect effects on the employer and employee offer a wide research field in the technical and professional area as well as in the more apparent aspect of the sociological ramifications. The purpose of this study is to consider one specialized area of the broad subject of post-retirement benefits; namely, the accounting and financing requirements and techniques incident to those plans qualified by the Treasury.

Much of the research in this study has been accomplished by case studies of corporations operating either a pension or profit sharing plan. Personal contact aided materially in the assimilation of the pertinent data for inclusion in this restricted study. The presentation of the factual material strengthens the conclusions reached.

Questionnaires were used in this study to substantiate earlier published results relating to the specific handling of pension information in the accounts and on the statements. No major change in accounting treatment was noted in comparing the results of the current survey with a similar survey conducted ten years earlier.

Books, periodicals, research bulletins, statutes, regulations, and writings of scholars in the field have been drawn from extensively to provide basic information for evaluation and review. Specific financing alternatives and accounting treatments are summarized and recommendations made in appropriate cases.

The results obtained indicate that the accounting practitioner through his individual contacts and through his participation in recommendations made by the leading professional accounting associations has provided effective guides for the profession. Uniformity in the treatment of pension costs on the financial statements may not exist to

the extent that the theorist desires, however it should be noted that full disclosure in the statements may be achieved in widely varying forms. The general agreement on the handling of past service cost as a charge to current expense rather than to surplus provides an example of the result of the widespread discussion on the alternative accounting treatments possible. As conditions change and additional procedures need to be developed, the accounting reporting is flexible enough to meet the demand yet maintain conformity with generally accepted accounting principles.

Labor and management negotiations often result in a new contract containing revised fringe benefits. The accountant is responsible to both parties to maintain the records and present such information at designated intervals that will be correct, informative, and understandable. Evidence is presented in this study to indicate that the accountant is doing an efficient job on this score.

Accounting has provided the answers to retirement financial problems that have been asked of it by management, employees, stockholders, tax authorities, and the public. With the increasing emphasis on old age security, the problems of the professional accountant will inevitably increase. The awareness of this responsibility should urge the accounting teachers and practitioners to do research, to publish articles, and to train staff replacements and additions to meet the needs of specialized reporting. A conclusion may be drawn from this study that concerted efforts are being made by the accounting group to accomplish this desired objective.

Microfilm \$3.25; Xerox \$11.25. 249 pages.

UNIVERSITY BUSINESS ADMINISTRATION IN YEARS OF DECISION

(L. C. Card No. Mic 60-1466)

Thomas Edward Glaze, Ph.D. Louisiana State University, 1960

Supervisor: Professor Leon C. Megginson

National interest is focused upon the colleges and universities in America to see how they will meet the greatest challenge in history during the coming years of decision. Surveys indicate that by 1970 enrollments may have doubled; plant facilities may have increased by 13 billion dollars (one-half as much as in all previous history); and faculties, staffs, and operational costs may have doubled.

This study has explored the aspects of university business management in relation to this challenge. Ideas were drawn from interviews with university administrators from presidents to minor faculty and administrative staff. The consensus of these interviews was that the major problem areas were planning, organizing, financing and fund-raising, operational policies, and leadership.

Ways and means of solution, in particular the principles of management, were studied for their applicability to the problems. The principles were found to have an apparent universal application to universities and industires alike.

Planning must keep its perspective and balance, and short-range needs and pressures should be made to contribute positively toward the long-range objectives. University administrators must be able to select the strategic factors from the myriad of problems. University administration can do little about such trends as junior colleges and branch universities, or political and trade union activity. Nevertheless these factors must be recognized and may have a decided effect upon the decisions of business management. Increased demand and short supply of teachers will cause an upward pressure on salaries. Proper administrative and financial balance between nine and twelve-months employees will be difficult to maintain. Emphasis on fringe benefits and participation in planning will assist these relationships.

University organization structures have tended not to be distinct nor well-defined, which is contrary to principles of good management. The organization structure represents people and more recognition must be given to the individual. Organizational delegation of authority is sometimes nullified in application by the veto powers of centralized management. For some unknown reason, universities have not promoted administrative training programs which have been found so beneficial to the perpetuation of management in industry.

In financing and fund-raising a public well informed as to the needs of higher education appears to be the single greatest need. The proportionate share of funds for higher education was found to be far below that of other state agencies. Tuition and fees from students present an inelastic demand and have little effect upon enrollment; the cost of living was determined to be the primary economic consideration. Corporation support appears to be the greatest potential for new sources of funds other than the government.

Operational policies of a university are largely matters of human relations in seeing that events conform to plans. Therefore, control measures, of which the budget is the most important, must be understandable and flexible and must emphasize preventive rather than corrective action. An excellent opportunity for self-evaluation of the institution's programs is afforded in budget preparation if the university management reviews them with all administrators.

Expansion of present plant facilities should be preceded by studies for effective utilization of existing space, and by efficient maintenance programs to keep that space usable. The financing of building programs must not divert or reduce normal operating funds for education, but instead it must be supplied only by added funds.

Administrative staffs must be trained in and exercise effective leadership. It is the dominant factor which must permeate all the functions of university business administration. Microfilm \$3.25; Xerox \$11.25. 250 pages.

THE EFFECTS OF PRICE LEVEL CHANGES ON INTER-INDUSTRY COMPARISONS OF INCOME

(L. C. Card No. Mic 60-1336)

T. Edward Hollander, Ph.D. University of Pittsburgh, 1959

Net income is an important measure of the success of business activity. Estimates of corporate income are useful: (1) in the evaluation of managerial effectiveness, (2) as guides to management in the establishment of corporate policies, (3) as an aid to the government in public utility rate regulation and in measuring the tax base, and (4) as guideposts in the allocation of resources within the economy.

Income is defined for a corporation as the maximum amount which can be distributed as dividends while the purchasing power committed to the capital of an enterprise at the beginning of the period is maintained intact. Income, as defined, best serves the objectives of income measurement.

The accountants' measurement of income in the economy is based on the assumption that the monetary unit of account is stable. Income as it is now measured in the economy based on the "stable monetary unit" assumption differs from income as defined in this study during periods of price level changes.

Price level changes distort the measurement of income by their varied affect on different revenues and expenses. Revenues and many of the expenses deducted from revenues to obtain income are measured in monetary units of current purchasing power. However, certain expenses, namely the cost of inventory used or sold and depreciation, are in monetary units of purchasing power of prior periods. Furthermore, purchasing power gains and losses are incurred on the monetary assets and liabilities of the enterprise. Adjustments of all expenses to monetary units of current purchasing power and adjustments of net income for purchasing power gains and losses are necessary in order to correct income for the distortion which results from price level changes.

The objective of this study was to determine the extent to which price level changes had distorted the measurement of income among seven industries in the years 1951 to 1956. An attempt was made also to measure the differences in the impact of price level changes among the industries.

Income reported in <u>Statistics</u> of <u>Income</u> was adjusted to current prices as follows:

- 1. The value of inventories used or sold in the current period was restated from original cost to current prices.
- 2. The expenses for depreciation, depletion, and amortization recorded on an original cost basis were converted to current prices by the application of weighted conversion factors. The conversion factors represented the weighted average change in prices from the period when plant and equipment were estimated to have been acquired to the current period. The weights were the expenditures on gross depreciable assets which were still on hand and depreciated in the current period.
- 3. Income was adjusted for purchasing power gains or losses on net monetary assets.

Income measured in accordance with current accounting practices was then compared with income adjusted for price level changes.

The quantitative impact of price level changes on three objectives of income measurement was determined. These objectives were: (1) the allocation of capital among industries on the basis of comparison of inter-industry rates of return on total capital employed, (2) the use of income as a basis for the determination of dividends, and (3) the use of income as a base for the calculation of the corporation income tax.

It was found that the reported rates of return and the rates of return adjusted for price level changes were

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different among the seven industries. Dividends paid as percentages of reported net income were found to be high in relation to income adjusted for price level changes among the majority of industries studied. The nominal tax rates also were found to differ from the effective tax rates among the seven industries. These differences were not uniform among the industries.

It was therefore concluded that the assumption of a stable monetary unit underlying current accounting practices in the measurement of income was not appropriate during periods of changing prices. Adherence to the "stable monetary unit" assumption has seriously impaired the validity and reliability of income so measured.

Microfilm \$4.30; Xerox \$15.10. 335 pages.

ECONOMICS OF THE AIR CONDITIONING INDUSTRY

(L. C. Card No. Mic 59-2672)

George Bernard Saunders, Ph.D. Syracuse University, 1959

Air conditioning machinery simultaneously controls air temperature, humidity, purity and motion. Drawings for the first truly scientific air conditioning installation were completed in 1902. Industry's first phase of growth was represented by the development of central station systems. These systems are large-capacity, site-assembled installations produced for the industrial-commercial market. Unitary systems--packaged, small-capacity units developed primarily for the residential market--were introduced early in the 1930's and offer an even more promising second growth phase. Each system is directed toward a particular category of customer and each presents different production and distribution problems.

Industry shipments of air conditioning machinery had reached an annual level of \$6,000,000 by 1920 and \$7,000,000 in 1956. In terms of physical volume, average annual growth through that period measured by a fitted second-degree trend line convex to the origin, was 12.8 percent. Air conditioning was expanding at a rate three times greater than all manufactures. Air conditioning average annual growth had risen from 9.2 percent in 1920-1925 to 17.1 percent in 1950-1955.

In 1956 there were almost 300 firms of a variety of types and sizes in the United States marketing one or more of the eight basic product lines. Central station equipment was marketed by 262 firms; unitary equipment by 88 firms. Fifty-one firms marketed both types of equipment Central station equipment manufacturers are less market oriented

than are unitary equipment manufacturers.

The introduction of Freon refrigerants and other technological developments made possible the design and production of unitary systems. In 1956 unitary shipments had risen to \$500,000,000, representing 71 percent of total annual industry shipments. Average annual unitary market growth equaled 29.7 percent. Sixty-six percent of all unitary systems shipped in 1956 were installed in residences. As of 1956, 14 percent of all single and two-family, non-farm houses were air conditioned.

There are few obstacles to entry into or exit from unitary production. Installation problems require an extensive distributor-dealer network for effective distribution. Promotional advantages accruing to large established firms handicap entering smaller, lesser-known firms.

Central station systems currently constitute 29 percent of total industry shipments. Average annual growth of this market subdivision is 8.2 percent. This market is concentrated in the hands of fewer firms because of production-engineering skills and the extensive capital investment required for central station manufacture. As of 1956 approximately 31 percent of all industrial-commercial establishments were wholly or partially air conditioned.

Average prices of unitary equipment directed toward the residential market have declined. Average prices of large capacity unitary equipment have risen. Central station equipment average prices fluctuate without discernible trend. Estimated labor, raw and finished materials

costs have risen steadily.

As of 1956 there is every indication that the industry will experience further expansion and will continue to develop in the oligopolistic market form. Profit margins for the Carrier Corporation, however, have not been excessive, averaging about 4.5 percent of net sales over the last twenty years. Carrier's profit margin is typical of firms in the industry. Unjustifiable excess capacity does not appear to exist. Selling costs are not excessive, varying from 10 to 15 percent of net sales. Product improvements are not withheld from the market. The industry's production concentration curve for its four, eight and twenty largest firms shows a pattern similar to that of machinery manufacturing. By any known standard of comparison the air conditioning industry is currently a workably competitive oligopoly.

Microfilm \$5.20; Xerox \$18.25. 405 pages.

AN EVALUATION OF DIRECT COSTING

(L. C. Card No. Mic 60-1378)

Gerald Oren Wentworth, Ph.D. Stanford University, 1960

This study is an evaluation of direct costing of recent prominence in accounting literature. Under direct costing, fixed factory overhead costs, otherwise included in product costs, are excluded from inventories on the theory fixed overhead should receive temporal rather than product identification. Prominent accounting authorities do not accept direct costing. Its status for preparing income tax return and its value in internal reporting are debatable.

This evaluation: (1) compares the results of direct and conventional costing; (2) reviews accounting developments leading to direct costing; (3) compares direct costing with marginal analysis as used in micro-economics; (4) correlates direct costing theory with accounting theory; (5) analyzes the impact of direct costing on users of accounting reports; and (6) reviews adoptions of direct costing as well as accountants' attitudes toward it.

Under direct costing: (1) reported inventories are lower by the amount of the fixed factory costs excluded; (2) reported net income, after the period of conversion to direct costing, may be either higher or lower;

(3) periodic net income is unaffected by customary accruals and deferrals of fixed factory costs; and (4), in the long run the total of period net incomes is relatively unaffected.

The adoption of direct costing is a marked departure from the conventional recorded product cost which includes fixed factory overhead costs. Its soundness depends upon conceiving of these fixed costs being temporal, a notion consistent with marginal analysis in the economists' theory of the firm. Direct costing also corresponds to concepts found in flexible budgeting and breakeven analyses. It is useful in assigning costs by line of responsibility.

According to a questionnaire survey, 113 respondents from auditing firms reported 115 direct costing clients. Of these 63 per cent filed tax returns and 65 per cent made financial statements incorporating direct costing. Nevertheless, these auditors cannot foresee formal acceptance of direct costing either among accountants or in our income tax structure.

Of 167 controllers of prominent manufacturing firms, 30 reported they already had, or intended to, adopt direct costing to meet such purposes as cost control and profit planning. Users of direct costing were satisfied with their systems and generally predicted more adoptions, a recognition of direct costs in income tax returns, and other general acceptance of direct cost reporting. Details of the findings from the survey of auditors and controllers are reported in 22 tables.

Auditors generally oppose direct costing, although it is conveniently reconcilable with conventional costing. This apparent hostility will decrease as auditors come to understand direct costing. Wherever a linear cost pattern prevails, direct costs are especially useful in internal reporting.

Tax returns incorporating direct costs will continue to be accepted, with the requirement that a special adjustment be made in the year of adoption.

Direct costing will become generally accepted. Direct cost statements are presently accepted without qualification by some auditors. Many auditors, industrial accountants, and controllers prefer such statements. From the standpoint of the primary recipient of published financial statements, the investor, direct costing statements provide more useful information than do the conventional type.

The study concludes with recommendations to associations of accountants that they re-examine their positions relative to direct costing, remembering that the principle objective of published financial statements is optimum disclosure of pertinent financial matters to their readers.

Microfilm \$3.60; Xerox \$12.60. 280 pages.

PREDICTING SUCCESS IN BUSINESS

(L. C. Card No. Mic 60-1379)

Frank Jefferson Williams, Jr., Ph.D. Stanford University, 1960

In the competitive business system of the United States, superior, imaginative leadership will probably become increasingly important both for company survival and growth and for the realization of the social benefits possible in a large population, a high level of education, and an advanced technology. Both undergraduate and graduate study in business have grown rapidly and business schools are now turning out a large number of potential managers for whom industry demand is great. The second exclusively graduate business school to be established, at Stanford University in 1925, is now one of the recognized leaders. From its inception primary attention of the School's basic two-year study program leading to the M.B.A. degree has been focused on the development of the generalist type of manager. Only those applicants who appear to have the greatest potential as future members of general management are accepted by the school.

However, little is known about how to recognize at an early age those individuals who will later distinguish themselves in career performance. The relative importance of such factors as the academic record, extra-curricular activities, faculty recommendations, scores on test predictive of business aptitude, interests, and the like, has not been established. As college enrollments and applications for graduate study expand it becomes increasingly important for both colleges and business to have this knowledge. If future success can be predicted, selection practices both of the colleges and of industry can be improved with the end result that on-the-job achievement will be greater.

This study is essentially a correlation study whose purpose was to determine whether any of the following 15 predictors, readily available to employers when the M.B.A. is granted, are related to business success: undergraduate grade point average; grade point average on required graduate courses; grade point average on elective graduate courses; scores on 7 scales of the Strong Vocational Interest Blank for Men; intelligence; undergraduate professors' ratings; and undergraduate extra-curricular activities of three kinds--athletics, non-athletics, and leadership.

The population studied consisted of the group of 220 male M.B.A. graduates of the Stanford University Graduate School of Business, classes of 1927 through 1943, who are working in business in 6 San Francisco Bay area counties. By repeated follow-ups, vocational histories of 196 men, 89 per cent of the population, were obtained. The group studied was generally financially successful (median 1957 income, \$14,500), interested in their work, and satisfied with their vocational progress.

The 116 corporate employees in this group were studied using an administrative level criterion composed of organizational level of authority, degree of participation in deciding over-all company policy, and remuneration. Sub-criteria weights were based on estimates of relative importance by a panel of 14 judges. Little agreement was found among judges' estimates and poor predictive results were attributed largely to the inadequacy of the criterion.

A criterion of job remuneration for the total group of 196 men was predicted with a multiple R of .50 (significant

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at the .05 level). Validities of individual predictors were not high but four r's were significant, leadership (.24) and the grade point average on elective graduate courses (.22) at the .01 level, and the M-F score on the Strong test (.19) and professors' ratings (.18) at the .05 level. Consequently, it was recommended that employers give relatively more weight to these factors in selecting M.B.A. graduates for general business trainees, and that the Graduate School of Business give somewhat more weight to leadership and professors' ratings than to undergraduate grades, activities, and admission tests in admitting individuals to graduate study.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

ECONOMICS, FINANCE

A CRITICAL ANALYSIS OF THE DEBT STRUCTURE AND DEBT MANAGEMENT IN LOUISIANA

(L. C. Card No. Mic 60-1461)

Joseph Maurice Bonin, Ph.D. Louisiana State University, 1960

Supervisor: Dean William D. Ross

This dissertation examines and evaluates Louisiana's debt structure and debt management. The experiences of the American states in debt management contribute to the development of "principles of debt management" which are the basis for this study. Other debt management principles are derived from the various factors considered by investment bankers and investor services in their analyses of bond issues. Since these groups prevail in the market, and since debt management must often be passive and adaptive, the various financial criteria must be recognized and exploited if state debt management is to be successful. Distinctions between proper and improper purposes of borrowing and safe and unsafe borrowing are examined. Other principles deal with bond provisions and the management of existing debt.

With the various principles established as standards, Louisiana's modern debt experiences are examined in detail. Individual issues are analyzed in terms of their purposes, their provisions and features, and their effects upon the debt structure. General tendencies observable only when issues are considered in the aggregate involve the timing of issues, the use of the call feature, the ratings received, and the administrative machinery. A major effort is made to emphasize both the desirable and the underivable machine.

sirable practices.

The findings in this study fall into two major categories: those applying generally to all states, and those findings particularly pertinent to Louisiana. Among the findings that may be appropriate generally on the state level are the following: (1) The techniques utilized by investment bankers and rating services in rating municipal bonds are not entirely pertinent to state bond issues, but they cannot be ignored and must be observed in debt management.

(2) The traditional market concepts of safety and propriety in borrowing do not take into account the fact that

considerations of what is proper and safe borrowing will depend greatly upon expectations of secular and cyclical economic conditions and upon what role the state government has been assigned under various conditions. (3) The planning and execution of debt policy should be keyed to the objectives of simplicity and stability. (4) The timing of bond sales and the reporting of debt are more important than is generally recognized. The value of debt reporting has been dramatically demonstrated in Louisiana. The use of a seasonal index to aid in timing bond sales is not a tested technique, but it would appear to warrant further study.

Louisiana has frequently violated the principles of good debt management; debt management has been characteristically uncertain and unstable. The State presently has no administrative machinery for coordinating, planning, authorizing, issuing, reporting, and retiring debts which directly or indirectly involve the State. A recent improvement in the management of highway finance has yet to spread to other areas of the debt structure.

Proposals for the improvement of Louisiana's debt structure and management are necessarily general because of the underlying philosophy that management requires flexibility. Nonetheless, it is clear that Louisiana's constitutional debt provisions need rationalization. Extensive planning would be necessary in the formulation of a desirable legal framework; even if a large-scale constitutional revision is impossible, planning would help to minimize the present legal impediments. The responsibility for debt management in Louisiana should be centralized in one or two debt units.

Microfilm \$6.20; Xerox \$22.05. 488 pages.

FORTY YEARS OF PROPERTY VALUES IN WISCONSIN

(L. C. Card No. Mic 60-1503)

John Hieh Riew, Ph.D. The University of Wisconsin, 1960

Supervisor: Harold M. Groves

This study traces the trends in taxable property values in Wisconsin over the past four decades: trends in such values for the State as a whole, for the urban areas of Milwaukee and Madison, and for the rural areas represented by several farm counties. The properties were classified by both type and use. More intensive study was made for the two urban areas; there, the changes in real property valuations were investigated separately for several divided areas.

Summarizing a few high points in the data, we observe that for the State as a whole improvements values increased nearly elevenfold but land values increased only a little more than 80 per cent. The weight of agricultural property in the real estate tax base dropped to less than half of its previous proportions; mercantile real estate has held its own; manufacturing has doubled and residential real estate has increased from 37.0 to 57.5 per cent of the total real estate. The latter since 1950 has provided more than half the real estate base. As to the relationship of land to improvements the overall ratio which

was once more than 1 to 1 has dropped to less than 1 to 3. Agricultural real estate is still more than half land; residential property, 16.7 per cent land, mercantile, 24.4; and manufacturing 6.6 per cent.

Metropolitan areas taken as a whole, improvements gained thirteenfold in Milwaukee and twentyfold in Madison from 1916 to 1958, and in both metropolitan areas the total land value gained about threefold. Improvements today hold 80 per cent or more of the total real estate value in these urban areas. The personal property once only one half or one third of the land in the cities now ranks equally with or above the land.

The gains in real estate value have been far greater in the central area of Madison than in that of Milwaukee. The differences in the age and the size of these two cities, the traffic facilities, and the rate of population growth as well as the peculiarity of the Capital Square of Madison as a grand administrative center seem to be the factors accounting for such differing trends.

When values are adjusted for price changes, it is only the outlying areas in which today's land value exceeds the peak values in the late twenties. In the downtown area of Milwaukee, the land value today is less than half of the 1916 value. As adjusted the total land value for the metropolitan areas of Milwaukee and Madison increased 21 per cent and 11 per cent respectively from 1916 to 1958, but the 1958 values were still below the early peak values.

Most striking fact in the series of date here presented is the failure of land values to maintain their relative place in the property tax picture. Transportation improvements has decentralized the cities and it is quite plausible to say that this has both checked and spread the economic rent of urban land. The tax system itself may also have had a substantial effect in preventing the rise in land values. Moreover, the rapid rise in improvements stimulated by the continually rising income and population has forced the land to the role of a declining importance in the total picture. In the past four decades, farm land values have failed to hold their own, even in depreciating dollars. The seemingly rapid rise during the post-World War II years were largely an inflationary distortion.

As to the practicability of land value taxation, the most serious challenge comes from the difficulty of revenue substitution. The dilemma lies in the reality that full exemption of improvements today is a rather difficult proposition from the revenue viewpoint, yet anything far short of this is not likely to yield the kind of incentive we would expect.

Land value in cities especially at their core might to some extent be restored by slum clearance and by transportation and parking improvements.

Microfilm \$2.75; Xerox \$9.70. 212 pages.

ECONOMICS, THEORY

ASPECTS OF THE THEORY OF
PRODUCTION AND PRODUCTION FUNCTIONS:
A MEASUREMENT OF PRODUCTION
FUNCTIONS FOR AMERICAN MANUFACTURING
IN 1949-1955 AND AN APPRAISAL OF THE
COBB-DOUGLAS METHODOLOGY.

(L. C. Card No. Mic 60-1254)

Tadami Tachino, Ph.D. The American University, 1960

The basic aim of the present study is an intensive exploration of the theory and measurement of production functions with particular reference to the Cobb-Douglas methodology as it is applied to the current economic situation. Cross-section production functions were measured for American manufacturing for each of the years, 1949-55, in order to probe into the economic problems and statistical difficulties entailed in the empirical derivation of production parameters, to test the consistency of these parameters with other economic facts and principles, and also to analyze the economic implications of the findings.

I. The study demonstrates that the basic problems of the empirical production function stems from the difficulty of obtaining a proper alignment of the variables. This difficulty, which transcends both temporal and timeless (cross-section) production functions, is inherent in the complexities of a dynamic economic life, and it arises mainly from the diffusion of enterprise activity which made the functional demarcations among industries increasingly obscure in recent years. Any industrial classification is bound to fall short of perfect concordance between product and industry statistics, and this fact limits a cross-section analysis to that of broad manufacturing aggregates.

II. The study illustrates an inevitable tendency for the regression coefficients to add up to unity, and the fact that k + (1 - k) approximates k + j makes immaterial in the end whether the exponent of capital is determined independently without the restriction of the linear homogeneous production function or whether this exponent is treated as residual value, and that, consequently, Durand's modification proves to be inconsequential in its ultimate effect. Although indispensable for Euler's theorem, the conditions of a linear homogeneous production function -- existing not so much as an explicitly imposed assumption but rather as an inevitable statistical constraint -- forms a conceptual barrier against linking the Cobb-Douglas "distributive" type production function with the traditional marginal productivity theory of distribution.

III.' The results also prove that the traditional notion that the actual shares of the factors of production should agree with their theoretical product requires a number of important qualifications. If it is to be argued that a disparity between the exponent of labor and the wage-product ratio denotes the degree of imperfect competition, it would be more realistic to expect, in view of the increasing monopolistic tendency, a disparity rather than an equality to prevail in the American manufacturing sector. In a growing economy, such disparity represents a source of capital formation and, while the aggregate wage-product ratio may decline, the value of k may rise, thereby further widening the disparity. The paradox appears whenever the sum of the constants does not correspond to unity, for if the

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factors were remunerated according to their marginal productivities, the entrepreneur would suffer a loss if the sum exceeds unity -- a fact which is incompatible with the concept that this condition denotes increasing returns to scale of production. If, on the other hand, the sum falls short of unity, this would then leave an unaccountable residual share in the total product.

IV. Analyzed in broad economic terms, the parameters derived for American manufacturing in 1949-55 exhibit analytically intelligible consistency with the extraneous

evidence of economies of scale, with yearly variations in factor proportions, and with long-term economic changes as viewed against the background of older parameters and the production functions of other countries. The shortrun and long-run variations of the parameters can also be rationalized in terms of the law of diminishing marginal rates of substitution and of the changes in the relative functional importance of labor and capital.

Microfilm \$2,55; Xerox \$8.80. 193 pages.

EDUCATION

EDUCATION, GENERAL

THE COLLEGE PROFESSOR IN THE NOVEL, 1940-1957.

(L. C. Card No. Mic 59-863)

Michael Victor Belok, Ph.D. University of Southern California, 1958

Chairman: Professor Brackenbury

This study examined the characterization of college professors in American novels published during the period 1940 through 1957. Fifty novels were selected from lists in the Book Review Digest, Fiction Catalog, and the Los Angeles Public Library bibliography of novels concerned with education. The novels were set in the United States, and professors were major or minor characters in each of them. The novels were, for the most part, serious in intent, and mysteries, fantasies, and romances were not considered.

An analytical instrument containing twelve categories was constructed, and the novels were analyzed in terms of these categories. The categories were (1) bibliographical data, (2) teacher character, (3) values, (4) achievement, (5) freedom, (6) why they teach, (7) human relationships, (8) teacher in the community, (9) attitudes, (10) summary of the novel, (11) author's background, (12) general ideas. Each category was refined by adding

subcategories and indicators.

Findings. The novels revealed that college teaching was considered a masculine occupation. The subject most commonly taught was English. Male professors were likely to be depicted as married; female professors were depicted as single and unlikely to marry. There were few data as to social origins. The professors were nonpolitical and conventional in behavior. Most male professors were depicted as well adjusted but slightly repressed. The female professors were portrayed as poorly adjusted and overly aggressive. The distinguishing characteristic of the male professor's physical appearance was tallness, and, for the most part, he was average in appearance. The female professor fell into two groups: the attractive and the unattractive. The most common goal was the desire for advancement. The professors were seldom exceptional scholars, and they were depicted as enjoying considerable personal and academic freedom. The novelists seldom bothered to explain why a man became a college teacher.

The financial position of the professor was not stressed in most novels. The professors were not active in community affairs, and their social life was restricted. Their human relationships were generally of a high order.

The analysis revealed several attitudes toward the college professor: (1) the male college professor us unworldly; (2) intellectual life may make him timid, shy, and repressed, or it appears to attract men of this type; (3) the male professor who is interested in the arts is unmanly; (4) the male college teacher is a second-rater; (5) intellectual activities unsex a woman; (6) the attractive woman, if she is a college teacher, is somehow different; (7) unattractive women are credible as scholars, and their occupational choice requires no explanation.

The analysis revealed a number of recurring male and female types among professors. The male types were the gentle scholars, the manly type, the aesthetes and climbers, the timid ones, the conscientious mediocrities, the persecuted Jew, the fogies, and the resentful man. The female types were the attractive woman, the unattractive woman, and the gentle scholar.

Conclusions. (1) The characterizations of the college professors tend to reinforce stereotyped notions and unfavorable attitudes about professors. (2) The novels in all probability damage the profession.

Recommendations. (1) Individual professors probably should try to develop critical ability in students so that the students may properly evaluate stereotypes and specious social attitudes found in the mass media. (2) A historical study of the college professor in fiction is desirable. (3) A study of the characterization of the professor in other mass media is desirable. (4) Fiction dealing with college life might be utilized in courses on higher education. Microfilm \$3.95; Xerox \$13.95. 306 pages.

EDUCATION AS A SUBJECT OF STUDY

(L. C. Card No. Mic 60-1353)

Charles John Brauner, Ph.D. Stanford University, 1960

This study attempts to ferret out the meanings embedded in the phrase "an intellectual discipline of education" by investigating ways in which the subject of education has been dealt with in the United States. Cast in the chronological framework of major changes in American educational thought, primary attention falls on analysis in the following areas:

- 1. Nineteenth century explanations of instruction and teacher training
- 2. Early twentieth century conflicting views of a science of education
- 3. Post World War I suggestions for unifying professional course work.

Monitorial method, object-teaching, Herbartianism, and child-study have been appraised as key nineteenthcentury antecedents to the idea that education might eventually become a science.

Monitorial Method: Before the Civil War, monitorial training explained particular technical skills of instruction and control in practical, descriptive terms which led toward non-theoretical talk about method.

Object-Teaching: Carrying monitorial practicality on into the post Civil War period, object-teaching broadened discussions of method. Yet interest in Pestalozzi's appeal for sympathy in child handling focused attention on introspection. Meanwhile Froebel's stress upon the symbolic and spiritual significance of objects had introduced speculation about educational concepts.

Herbartianism: Under Herbartian influence the objectteaching trend toward psychological introspection and philosophic speculation took precedence over matters of technical skill and instructional method. The logical relation of talk about human nature to instructional practice initiated the first attempt at building a comprehensive educational discipline.

Child-Study: Opposed to the Herbartian emphasis on logical theories about human nature, child-study concentrated upon the observation of children. This yielded a body of reports which would become the initial content of education as a descriptive science.

Reflecting increased complexity in discussions of education, these nineteenth century viewpoints set the pattern of controversy within which conflicting views of a science of education found expression early in the twentieth cen-

Ideas about science made popular by Thomas Henry Huxley, Charles Peirce, Josiah Royce, William James, and John Dewey give general meaning to the differences between Herbartian and child-study concepts of educational science. Coupled with statements by such investigators as Hugo Munsterberg, Paul Monroe, and Edward L. Thorndike, these conceptions of science promoted the idea that an educational discipline must be distinguished from the task of training teachers by emphasis upon scholarly descriptive research.

Though a clear notion of observation-centered science was being ably fashioned around 1912, a considerable gap developed between it and the kind of content achieved by the measurement and survey movements which emerged about the same time. Reasons for the gap have been sought by comparing Paul Monroe's Cyclopedia of Education of 1911, and Walter S. Monroe's Enclyclopedia of Educational Research of 1941.

The discrepancy between the advocacy of educational science and the limited findings of measurement research bred dissatisfaction in those needing theories to give substance to teacher training. To keep scientific findings basic to teacher training John Dewey wrote The Sources of a Science of Education in 1929. Comparison of this book with writings of Harold O. Rugg and others reveals it as the source of the "foundations of education" concept propounded at Teachers College, Columbia University in the early 1930's. Going beyond Dewey, however, Rugg and his associates promulgated a program which synthesized information from all sources, not merely from science.

As Herbartianism had done earlier, the "foundations" concept made the study of education theoretical at the expense of careful scientific description. It thus obscured the distinction between a discipline of scholarly research and content useful in the practical task of training teachers.

Microfilm \$4.40; Xerox \$15.55. 344 pages.

A STUDY OF TEACHER EDUCATION AND CERTIFICATION FOR THE TEACHING OF MUSIC IN CANADIAN PUBLIC SCHOOLS

(L. C. Card No. Mic 60-1404)

Alfred Malcolm Brown, Ed.D. The Florida State University, 1960

An investigation of several aspects of the preparation and certification of public school teachers in Canada was carried out specifically with regard to music as a partial requirement. Data were acquired from authoritative sources, organized province by province and presented in such a manner that they could be compared and contrasted with recommendations and practices obtaining in the United States.

Letters were written (1) to all provincial departments of education in order to obtain reliable information concerning the certification of teachers in Canada, (2) to all colleges, universities, and teacher training institutions in Canada offering programs acceptable for purposes of teacher certification requesting calendars (bulletins) pertaining to the school year 1956-57. Subsequently, it was found that Catholic normal schools in the Province of Quebec do not publish calendars. It was, therefore, decided to endeavor to procure appropriate data from those sources through preparation and distribution of a questionnaire instrument.

From correspondence and materials received, information was extracted pertaining to the following areas: (1) regulations governing certification of Canadian classroom teachers with special reference to music as a partial requirement; (2) data pertaining to music course content offered in institutional programs for the preparation of Canadian classroom teachers; (3) regulations governing

certification of school music teachers in Canada; (4) data pertaining to the content of institutional music programs acceptable in Canada for purposes of certification.

For the purpose of drawing comparisons between Canadian data and recommendations and practices obtaining in the United States, American standards selected were those compiled, promulgated and reported by (1) the Music Educators National Conference and (2) the National Education Association.

In only one particular was there found to be uniformity of practice throughout the Dominion of Canada: in every province, authority for certification is vested in the department of education. In all other matters, wide differences in organizational patterns and practices were found to exist.

With reference to Canadian classroom teacher preparation and certification, the following findings were reported.

- (1) In five provinces at least some opportunity is open for candidates to be certified as elementary teachers without receiving any music training, one province requiring no music at all.
- (2) Only two provinces require music training for all teachers, elementary and secondary.
- (3) In eight provinces candidates may be certified to teach upon completion of a one-year program in professional education subsequent to high school graduation.
- (4) In a majority of provinces programs for secondary school teachers do not require music courses for graduation.
- (5) There is no instance in which preparation for elementary teachers conforms to MENC recommendations.
- (6) Concerning comparison with certification practices obtaining in the United States, common trends were noted; e.g., in the majority of instances three semester hours or less in music are stipulated for certification.

In reference to certification and preparation of Canadian school music teachers, high standards in applied music are required for entrance to undergraduate music programs affording more time for professional music education than in American programs; therefore, Canadian standards in general appear to be higher. However, wide variations in Canadian requirements for graduation are evident, and each program must be evaluated according to its own merits. In some provinces, notably in Ontario with its large urban population centers, standards for certification requirements are very high, while in other provinces very low standards are in effect.

It is hoped that this investigation and comparison might serve not merely as a status report, but also as an instrument of some value in estimating credit for transfer of students and teachers between Canadian and American institutions and educational systems as well as for interprovincial transfer of such personnel.

Microfilm \$6.60; Xerox \$23.40. 518 pages.

COUNSELEE PERCEPTIONS OF THE COUNSELING PROCESS IN CALIFORNIA JUNIOR COLLEGES

(L. C. Card No. Mic 60-1346)

Robert Douglas Duke, Ed.D. Stanford University, 1960

This study is concerned with the junior college students' perception of his relationship to his counselor, the interview process, and counselee views of various situational factors which are operative at the junior college level.

A questionnaire of 27 items regarding counseling was constructed and administered to 339 students in four institutions in metropolitan Southern California.

The answers to eight specific questions were sought, as follows:

Question one asks, "Will students who indicate that their counseling has been satisfying also indicate that their counselors behave in specified ways which the theoretician generally agree are good counseling techniques?" The results of a test for significance of difference show that satisfied and dissatisfied students perceived their counselors behaving in "approved" fashion, but satisfied students saw their counselors so behaving to a greater degree than did the dissatisfied.

Question number two is an item by item analysis of counselee response to questionnaire items, and asks "Will students who indicate dissatisfaction with counseling indicate their counselors do not act in accordance with generally approved techniques?" The resulting chi square values show (1) the large majority of satisfied students indicate their counselors follow "approved" techniques, (2) a lesser majority of dissatisfied counselees indicate counselors follow these techniques.

Question three asks "Will students who have had personal counseling indicate some significantly different reactions to the counseling process, as herein defined, from those who have not undergone personal counseling?" Chi square values showed that on 13 of the 27 items of the questionnaire there were a significant difference between the two groups. The personal counseling groups perception was generally more favorable than that of the non-personal counseling group.

Question four asks, "Will those who have had personal counseling have a counselor sex preference regardless of the matter discussed?" Analysis by use of the chi square technique showed that on one of the four sex related items of the questionnaire there was a significant difference between the two groups. Specifically, a small minority of the personal counseling group desired a like-sex counselor in discussing personality adjustment and how to be well liked, while a majority of the non-personal counseling group so indicated in this situation.

Question five investigated counselor sex preference in relation to satisfaction in counseling. No relationship was found between counselor sex preference and satisfaction in counseling.

Question six asks, "Whether in situations where academic matters only are discussed, most students will feel that the sex of the counselor is unimportant? A test for significance of differences revealed that significantly more than half of the students felt that in such situations the sex of the counselors was unimportant.

Question seven asks "Will the majority of students have met with their counselors regarding academic matters only?" A test for significance of difference showed that significantly less than half the students had met with their counselors regarding personal or emotional problems.

Question eight asks, "Whether a significant number of students desire but do not have a member of the faculty with whom they could discuss personal problems?" The resulting value of chi square show that the wish for a personal counselor and feeling that there is one present tend to be correlated.

The study points up three generalizations regarding counseling, as represented in the investigated institutions.

(1) There is a common, modal perception of the counselor and the counseling process. In general, this perception is positive.

(2) There is a differential perception held by a minority of students whose size is large enough to indicate that an investigation of the reason for such opinion seems warranted.

(3) Situational factors affecting such perceptions are present, and are discussed within the body of the work.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

A STUDY OF THE SOCIAL PHILOSOPHIES OF THREE MAJOR INTEREST GROUPS OPPOSED TO FEDERAL AID TO EDUCATION

(L. C. Card No. Mic 60-330)

Father Everest John Michael Farnand, O.F.M., Ph.D. St. Louis University, 1959

Our complex American society comprises many organized interest groups. A basic assumption exists that these groups have consciously or unconsciously developed a social philosophy. In seeking a verification of this assumption, three major interest groups were selected in reference to their unanimous opposition to Federal aid to education. The three organizations chosen for the study were The American Farm Bureau Federation, The Chamber of Commerce of the United States and The National Association of Manufacturers.

The procedure of the study was to analyze the publications and public pronouncements of the three organizations in order to ascertain each organization's social philosophy.

Since the philosophy of an organization is often reflected in its origin, a history of each group was indicated. The historical chapters of the study contain the origin, purpose and activities of each organization.

To provide background for a better appreciation of the interest of the study, the public image of the businessman and farmer was portrayed. The contemporary social self-image of the business man and farmer was also expressed. The latter concept was obtained on the basis of personal interview and a questionnaire.

The general analysis indicated that all three interest groups have a social philosophy which is basically conservative. A strong influence of materialism and pragmatism is also noted. This is the case more so with the business groups than with the farm units.

In respect to government, all groups agree that the function of government is political, not economic.

Although decentralization of government is favored, one of its proper political functions is to foster and protect business interests. The rights of the individual in a free enterprise system is the American heritage guaranteed by the Constitution and the Bill of Rights.

In respect to man, every human being is possessed of dignity and worth. Although individual ambition is the most universal, reliable, and powerful of human motives, conformity to the existing mores, regardless of their socialistic trend, is marked in business concepts. Economic pre-eminence and material standards of value overshadow human values, and foster elitism among businessmen which is increasingly devoid of humaneness.

In respect to society, social changes are inevitable but are to be introduced cautiously. Economic interests are judged as pre-eminent interests of society. Farmers tend to place home and family interest above economic values.

The social philosophy has influenced education both administratively and academically. Some administrators are businessmen rather than educators. Curriculum changes are those which de-emphasize the humanities and encourage practical business and vocational programs. This particular aspect of the over-all philosophy reflects the spirit of pragmatism which is prevalent in the American public school system.

Effectively, the order of values which rules in the three major interest groups is materialistic. Theoretically, human values are upheld as the values which rule.

Lack of integration is noted in the concepts of the social philosophies of all three interest groups.

Microfilm \$2.50; Xerox \$7.20. 152 pages.

MIGRATION OF NOTABLES TO AND FROM THE SOUTHEAST

(L. C. Card No. Mic 60-658)

Alto Luther Garner, Ed.D. University of Kentucky, 1954

The purpose of this work was to determine whether the Southeast was losing or gaining notables through the process of migration, a notable being defined as one listed in Who's Who in America, 1952-53.

The migrant notables were compared not only by the place to which or from which they migrated but by: the occupation or occupations in which the individual engaged; by the age of the migrant at the time of migration and at the time of the study; and with reference to those engaged in education according to teachers and administrators.

Further study is recommended to evaluate tendencies pointed up in the different states to seek explanation for what are seeming contradictions.

Since the occupation in which the Southeast had its greatest losses was business, it is recommended that the tremendous amount of work that has been done and is being done to bring about a greater diversification of industry in the nation be stepped up.

Since it is known that educational opportunity is in many instances limited in the Southeast; and since it was demonstrated that many leaders left the Southeast because of the desire to obtain an education outside the Southeast; it is felt that any improvement in this area will be richly rewarding not only for the South but for the nation.

The recent Supreme Court decision on segregation should eventually increase opportunities in such a way that the migration of colored people from the Southeast would be substantially reduced.

Microfilm \$7.05; Xerox \$25.00. 554 pages.

A STUDY OF PROGRAMS FOR ADVANCED DEGREES IN SCHOOLS OF EDUCATION IN CANADA

(L. C. Card No. Mic 60-1514)

George Arthur Graham, Ph.D. Washington State University, 1960

The purpose of this study is to make a survey of the requirements and practices in force at the present time in Schools, Faculties, and Departments of Education in institutions of higher learning in Canada which offer master's, licence, and doctor's degrees in education, and to determine which policies and practices appear to be most satisfactory and least satisfactory as judged by both the administrators of the programs and the graduates who have spent a year in the field after having received advanced degrees in education.

A questionnaire was devised and sent to the administrators of the programs at the eighteen institutions offering graduate work in education in 1957-58. Also, a postal card questionnaire was sent to 160 of the 1956-57 graduates of advanced degree programs in education to obtain their evaluation of the programs under which they studied. The questionnaire replies from seventeen schools and postal card responses from ninety-nine graduates, along with whatever information was available in the catalogs of the eighteen institutions surveyed, provided the data for this study.

The results of this survey can be summed up as follows:

- 1. There is much variation in regard to requirements and practices in the various institutions, and this lack of uniformity is noticeable in nearly all phases of the school program. This is especially so in regard to course work and time requirements.
- 2. By far the greater number of responses from the graduates concern course work. They want the curricula offerings expanded, not only in regard to professional courses, but in the general education area as well. They also feel the need for improvement of present course offerings, especially in regard to putting more content into the courses and making them more practical.
- 3. The graduates also suggest other ways in which the instructional program can be improved. They feel the need for more seminar type classes, workshops, field studies, etc. They would like the instructional program to be as practical as possible and worthy of graduate recognition.
- 4. The course requirements seem to be concentrated around education subjects, with no minor outside of education being required. According to the questionnaire responses, a number of graduates feel that more courses outside education should be provided to make possible a well-rounded program.

5. A survey of the questionnaire returns also indicates that some graduate programs in education are not yet firmly established, and that advanced degree programs are being attempted where interest is insufficient or the enrollment is too small to make such programs practical.

As a result of this study, the following recommenda-

tions are presented for consideration:

- 1. Careful study should be given to the establishment of standard requirements and practices for advanced degree programs in education.
- 2. The present instructional program should be thoroughly studied with a view to expanding course offerings where necessary and advisable, and to improving present courses to make them more effective.
- 3. Provision should be made for more seminar type classes and workshops.
- 4. Study should be given to course work in regard to major and minor requirements. A minor outside of education may be desirable.
- 5. The enrollment problem should be studied by some institutions. If enrollment is not sufficient to warrant advanced degree programs in education, study should be given to some plan for concentration of graduate programs in cooperation with other universities.
- 6. A program of evaluation of established procedures with a view to improving them should be instituted at each university offering graduate work in education.

Microfilm \$2.50; Xerox \$7.60. 164 pages.

A STUDY OF VOCABULARY LOAD AND SOCIAL-CONCEPT BURDEN OF FIFTH AND SIXTH GRADE SOCIAL STUDIES, HISTORY, AND GEOGRAPHY TEXTBOOKS.

(L. C. Card No. Mic 60-1335)

Hyman Haffner, Ph.D. University of Pittsburgh, 1959

The purpose of this study was to analyze selected publisher-designated fifth- and sixth-grade social studies, history, and geography textbooks in order to determine and compare the reading grade level, the vocabulary load, and social-concept burden of these textbooks.

The problem lent itself to five specific elements. They were (1) to establish the reading grade level of the selected textbooks; (2) to determine the vocabulary load of each textbook; (3) to compile a list of concept words that have social significance; (4) to determine the social-concept burden of each textbook; and (5) to develop, using the Yoakam Readability Formula, an objective method for comparing the social-concept burden of the selected textbooks.

The textbooks included in the study were obtained from a bibliography provided by the National Council for the Social Studies. A letter was written to each publisher explaining the purpose of the study and 42 textbooks were submitted for evaluation. When the books were received they were analyzed as follows: (1) the grade level of each book was determined by applying the Yoakam Readability Formula; (2) all words having a Thorndike rating of four or more were noted as contributing to the vocabulary load of the textbooks; and (3) social-concept vocabulary was determined by a committee of five Pittsburgh educators.

The data collected were analyzed in the following manner: (1) the grade level as indicated by the publisher was compared to the grade level as indicated by the Yoakam Formula; (2) the vocabulary load of the textbooks was analyzed; (3) the social-concept burden was studied and an objective method for comparing the social-concept burden of the selected textbooks was developed; and (4) conclusions suggested by the data were presented.

The data seemed to warrant the conclusions that sixth-grade textbooks would present less vocabulary difficulty than fifth-grade textbooks; both fifth- and sixth-grade textbooks contain excessive vocabulary loads and concept burdens due to the number of Thorndike rated words of four or more rather than the difficulty of particular words; and the social-concept burden is greater in sixth-grade textbooks than in fifth-grade textbooks.

Microfilm \$2.50; Xerox \$7.40. 158 pages.

THE APPRAISAL OF THE BEHAVIOR OF THIRTY SEVERELY MENTALLY RETARDED CHILDREN, THEIR PARENTS, AND SIBLINGS.

(L. C. Card No. Mic 60-385)

Frances Aliene Scott, Ph.D. Syracuse University, 1959

Supervisor: G. Orville Johnson

This study was concerned with appraising the behavior of thirty severely mentally retarded children, their parents, and siblings. Data bearing on the relationship of certain parent behavior variables to behavior variables of the mentally retarded children and their 64 siblings who live in the homes were also included.

Behavior variables rated were those measured by the Fels Parent, and Child Scales. Social maturity levels of the 30 subject children were measured by the Vineland Social Maturity Scales.

The data were gathered in two observational visits to 30 white, native-born families from urban, suburban, rural, and remote areas of two eastern states.

Criteria used in selecting the 30 subject children prevented random sampling. Children chosen were the first found who met the criteria:

- 1. Chronological age approximately 7 to 12
- 2. Intelligence quotient approximately 25 to 50, determined by individual intelligence tests
- 3. No severe physical disabilities
- 4. Not more than one-half to be mongoloids
- 5. At least 2 siblings living in home
- 6. As evenly divided, males and females, as could be found to meet the criteria
- 7. Homes as evenly divided, socio-economically, as possible

Siblings of the subject children, ranging in age from one month to over 30 years, numbered 94, of whom 84 lived in the homes. Sixty-four of these siblings were available for rating.

The reliability of the investigator as a rater was established by visiting in three homes with a clinical psychologist. Following each of these visits, the psychologist and the investigator, working individually, rated each parent, subject child, and sibling on the appropriate Fels Behavior Scales. The two raters then compared and discussed their ratings. Inspection of the two sets of ratings gave evidence of the investigator's ability as a rater.

The investigator made two observational visits to each home. The Vineland Social Maturity Scale was completed on the subject child during the first visit. Usually, the mother was the informant. Following each visit each parent present was rated on the Fels Parent Behavior Scale, and the subject child and all available siblings were rated on the Fels Child Behavior Scales. Each observational visit was also recorded in detail.

The ratings were analyzed by the cluster analysis, described by Baldwin, and the results were discussed in detail.

Pearson Product Moment Correlations were also obtained for four categories of relationships:

- 1. Mother's behavior-behavior of siblings
- 2. Mother's behavior-behavior of mentally retarded children
- 3. Behavior of mentally retarded children--behavior of siblings
- 4. Mother's behavior--differences in behavior of mentally retarded children and siblings

Results

- On Rank-Sums Test, fathers' behavior did not differ significantly from mothers' except in: Duration of Contact, Emotionality, and Affectionateness.
- 2. Behavior of mothers showed some extremes but in general their ratings indicated moderation.
- Behavior of the mentally retarded children differed in varying degrees from the siblings' on all variables tested.
- The mentally retarded children were also found to be socially immature in all aspects of their daily living.
- 5. Behavior of the mothers on certain variables was significantly related to that of the children.
- Behavior of siblings and mentally retarded was found to be significantly related to certain of the relationships tested.
- 7. Behavior of the mothers was found to be significantly related to differences in behavior of mentally retarded children and their siblings on certain of the relationships tested.

Because of the small number of subjects, further study along these lines appears indicated.

Microfilm \$3.75; Xerox \$13.30. 291 pages.

AN ANALYSIS OF BASAL READER STORIES WITH CULTURAL SETTINGS OUTSIDE CONTINENTAL UNITED STATES

(L. C. Card No. Mic 60-1264)

Mildred Mulkin Smith, Ed.D. Indiana University, 1959

Chairman: Hanne J. Hicks

Problem

The purpose of this study was to analyze the treatment of other cultures in American basal reader stories in relation to their developing the social studies objective of an understanding acceptance of world neighbors.

Procedures

As a result of an examination of all the basal readers on levels from first through sixth grade published in the United States in 1957, the investigator located four hundred and six stories which apparently were written about present world neighbors. They were classified under sixty-four countries and seven cultural areas. Four hundred and four people read a story or stories about a country in which they had lived. Each evaluated the accuracy and realism, giving supporting data for opinions. On the average, each story was evaluated five times.

Findings

- 1. There was a marked diversity of opinion about only three of the four hundred and six stories.
- 2. Some stories about a limited geographical area failed to point out that they did not represent the whole country.
- 3. Picturesque minority groups, especially poverty stricken groups, were portrayed in a large number of stories. Educated, urban, and industrial groups were ignored to some extent.
- 4. In some stories, poor children of the world appeared plump, well-fed, and well-clothed in most illustrations.
- 5. There were a number of stories where illustrations, text, or both were about past customs presented as being currently typical.
 - 6. Some stories portrayed countries as they never were.
- 7. A large group of modified American stories had the children act like American children instead of like children of the culture named.

Conclusions

- 1. A few corrections of apparent errors in illustrations and background details would make many stories more accurate and realistic.
- Stories with misleading information on the culture named should be eliminated so as to avoid false social concepts.
- Some stories at every grade level except the first appeared to present other cultures with accuracy and understanding.
- 4. Another group of stories had nothing in them that evaluators considered contrary to custom. Neither did they have any thing especially typical of the country they

were about. Such stories appear to have their place in emphasizing the similarities in culture but they do not seem to contribute to an understanding or acceptance of dissimilarities.

5. A comparison of the stories in some of the newest revisions with earlier editions of the same reader indicated, for some publishers at least, a trend toward replacing stories about other cultures with stories of magic and whimsy. Some of the stories eliminated in the newer editions might very well have taught accurate social studies concepts if a sentence or two had been deleted to bring the stories up to date.

Recommendations

Subject to the limitations of the study, the findings appear to justify the following recommendations.

- 1. Before publication, inaccuracies in background details, foreign words, geographical locations, historical facts, and illustrations should be corrected. It is not the purpose of the elementary school to teach inaccuracies.
- 2. Except for a very particular purpose, stories about large countries should not be concentrated about one geographical section or one class of people. A well-rounded portrayal of a country has the advantage of being representative.
- 3. The use of stories in teaching social studies concepts probably would be facilitated if the stories stated what countries they were about, what locale in large countries, and if the teacher had a list of stories arranged by country and grade level.

If these things were done, then basal reader stories might be an effective tool for developing socially efficient attitudes toward world neighbors.

Microfilm \$3.25; Xerox \$11.25. 249 pages.

TEACHER AWARENESS OF SOCIO-CULTURAL DIFFERENCES IN MULTI-CULTURAL CLASSROOMS

(L. C. Card No. Mic 60-1261)

Horacio Ulibarri, Ed.D. The University of New Mexico, 1960

The Problem

The purpose of this study was to determine the extent of awareness among selected teachers of socio-cultural differences as they affect the education of Spanish-speaking and Indian children in New Mexico.

The Hypothesis

The hypothesis was that teachers are not aware of many of the socio-cultural factors that affect the education of children from minority groups.

Procedures

The study was divided into five parts: (1) review of the pertinent literature; (2) formulation of a questionnaire from the literature; (3) selection of a sample of elementary teachers who were currently teaching at least two cultural groups and who had had experience with the third group, and selection of three control groups, each of

which was teaching only one cultural group; (4) an interview schedule; and (5) an analysis and interpretation of the data.

The questionnaire contained twenty items which covered: (1) psychological needs of children in relation to socio-cultural differences; (2) cultural orientations; (3) social conditions; and (4) educational problems.

The interview schedule was limited to teachers teaching Anglo, Spanish-American, and Indian children and was

made personally by the writer.

The rank assigned to each group, that is, Anglo, Spanish-American, and Indian, and the amount of agreement in assigning such a rank by the teachers, were found by using the mean and standard deviation of each scale. The coefficient of concordance showed teachers' agreement in assigning similar ranks to the three groups. The Rho coefficient of correlation showed the extent of agreement between sample and control groups.

Findings

Most items showed a general lack of sensitivity toward differences in socio-cultural conditions and orientations among the three ethnic groups. The teachers failed to show any awareness regarding the ability of the different children to use the textbooks prepared for their grade level, although they indicated strong awareness of differences in proficiency in the use of English. The teachers were very much aware of differences in general home environment of the three groups, but they failed to differentiate specifics in life-space and their implication for education. The teachers indicated a lack of sensitivity in relation to motivational patterns of, and motivational structures applicable to, Indian and Spanish-American children. The teachers showed little awareness of differences among the groups in their use of school-taught concepts of citizenship in their out-of-school life, and they thought that all groups were interacting quite well with one another. Finally, the teachers failed to show an awareness of the different ways in which the psychological needs of children from different cultural backgrounds must be

Implications for Education

Teachers, generally, are following an undifferentiated curriculum geared to middle-class values. Provisions for language development are inadequate. Motivational structures applicable to middle-class pupils are not applicable to all children in a multi-cultural situation. The curriculum is not equated with the experience level of children and intergroup relations are not furthered. The ultimate objective in the education of minority group children has not been decided by those concerned. Is the objective of education merely to prepare these children for life back in the traditional culture, or is it to prepare them for complete acculturation and assimilation into the dominant society?

Recommendations

Pre-service and in-service education should be geared toward understanding of socio-cultural factors as they affect the education of minority group children.

Further study is needed to determine the social distance between middle-class teacher and lower-class student; to determine more efficient methods of overcoming language, experience, and culture handicaps; and to modify

administrative competencies in pupil-personnel service, school-community relations, and staff personnel in schools serving bicultural children.

Microfilm \$3.15; Xerox \$11.05. 241 pages.

EDUCATION, ADMINISTRATION

AN INSTRUMENT FOR SCHOOL ADMINISTRATORS TO USE IN MEASURING COMMUNITY ATTITUDES AND PREJUDICES

(L. C. Card No. Mic 60-1524)

William Arthur Anderson, Ed.D.
The University of Nebraska Teachers College, 1960

Adviser: F. E. Henzlik

Purpose of the Study

The purpose of the study was: (a) to develop an instrument for measuring the attitudes and prejudices of a community in those areas of most significance to school administrators; and (b) to devise a method of application of this instrument which was inexpensive, accurate, and easily administered; and (c) to formulate a meaningful method of tabulation and exposition of the results.

Method of Procedure

Advantages and disadvantages of different methods of attitude measurement were assessed from the literature. Standards were established for the instrument and its application to insure practicality and usefulness. A questionnaire was accepted as best meeting these requirements if the disadvantages of both the mail-type and strict random sampling were overcome by use of the McCormick Method.

Ten distinct areas of attitudes and prejudices were gleaned from the literature and a selected group of super-intendents ranked them in order of importance in their communities. The four areas of most importance were social customs, economic status, school and its activities, and religion. A questionnaire composed of fourteen statements and three action questions in each area was formulated with the order of questions determined by lot.

The instrument was applied twice to the pilot center utilizing both the McCormick Method and a strict random sampling technique. Results by areas and special groups

were compared using the t-test.

Another application using the McCormick Method was made in an adjoining community. This center seemed similar in three areas but was markedly different in the area of social customs having great pride in its Swedish ancestry. Comparisons were made to see if the results verified the original assumption.

Interpretation of results was made in terms of comparisons between communities or between groups within the same sample. No attempt was made to develop a standardized score for the instrument since questions were not equally weighted.

Conclusions

School children in the junior high age group are an excellent means of distributing and recovering survey materials for school purposes.

The McCormick Method of sampling is ideally suited

for this type of survey.

The McCormick Method produces a high rate of returns and can be completed in less than one week's time.

Tabulation of the information on the cover page provides the surveyor an analysis of the internal composition

Charts or graphs are quite meaningful in showing comparisons between groups or communities.

The direction of a community's score is neither good nor bad but must be interpreted in light of the answer used

in the scoring key. Sex and occupations were two factors which seemed to

have little significance in the four areas except women scored higher in schools and businessmen scored higher

in economic status.

The instrument was assessed to be valid in three ways: first, applying the same instrument twice by different methods in the same community yielded the same results; second, the same instrument applied to a different community yielded different results; and third, the results were representative of conditions known to exist in both communities.

Applying the t-test to both samples in the pilot center showed all areas to be well within the limits of significant difference.

Tabulation of the results in the adjoining community showed a significant difference of 3.87 in social customs.

Attitudes in the samples were found to have a clustering effect with those having the strongest attitudes in one area tending to be equally so in other areas as well.

A certain degree of the community's attitude can be estimated with some success by a knowledge of the internal composition of the community.

Microfilm \$2.65; Xerox \$9.25. 202 pages.

THE CHARACTERISTICS OF SUCCESSFUL SCHOOL SUPERINTENDENTS

(L. C. Card No. Mic 60-1307)

Frederick Winslow Bewley, Ed.D. University of Southern California, 1960

Chairman: Professor Nelson

The purpose of the study was to identify the characteristics of a group of twelve school superintendents who, on the basis of their administrative behavior, had been adjudged successful superintendents.

Findings. The superintendents studied were observed to have both similar and dissimilar characteristics, and within each of these categories there were characteristics classified as administrative practices and personal qualities which were noted by the observers. The similar administrative practices were as follows: (1) authority and responsibility were delegated to subordinates; (2) capable assistants were employed; (3) employee individual

differences were recognized; (4) the school districts operated on staff-developed, board-adopted, written policies; (5) channels of authority were clearly defined and followed; (6) employees' accomplishments were seen and acknowledged publicly; (7) democratic administrative procedures were followed; (8) administrative advisory groups were used; (9) the men were good listeners; (10) disagreeing opinions were tolerated; (11) channels of communication were kept open; (12) loyal support was given to staff members; (13) new trustees were oriented to their positions; (14) the men were active in civic affairs.

The similar personal qualities observed were honesty, a high energy level, broad knowledge, a deep concern for

others, and approachability.

The dissimilar administrative practices were as follows: (1) variation was seen in the speed and manner in which decisions were made; (2) lay advisory groups were used in many ways and for a variety of purposes; (3) social contacts with the staff ranged from frequent to seldom and formal to informal.

The superintendents displayed wide differences in such personal qualities as personality, sense of humor, selfcontrol, vision or insight, ability to inspire, and professional appearance.

Conclusions. Critical analysis of the data led to the formation of five conclusions, the first three of which indicated that the hypotheses were true. (1) Successful superintendents exhibited characteristics which, though they varied in prominence among the men, were observed in at least ten of the twelve individuals. (2) Certain characteristics were displayed by only a minority of the superintendents but were considered to have been important factors in the success of the possessors. (3) School trustees and employees perceived the superintendent differently and held unlike expectations for his behavior. (4) Success came to the superintendents partly because they possessed certain qualities and followed certain practices, and partly because they skillfully used their own unique characteristics. (5) Successful superintendents tended to be more similar in their administrative practices and less similar in their personal qualities.

Recommendations. The findings and conclusions led to six recommendations: (1) Superintendents should make a critical comparison of their own characteristics and those of the successful superintendents studied, and consider the applicability of those which suit their own capabilities. (2) In employing a superintendent governing boards should make a partial evaluation of the candidates by comparing their characteristics with those of the successful superintendents studied. (3) When forming judgments of a superintendent's performance, trustees and employees should recognize the conflict of interests created by their divergent expectations. (4) A superintendent should strive to capitalize on his unusual personal qualities, recognizing that even a peculiarity can be an asset if skillfully handled. (5) The near unanimity with which the successful superintendents used the similar administrative practices indicates that these practices promote more effective administration. (6) More specific research should be applied to individual characteristics, for instance, personality, and their bearing on the success of superintendents.

Microfilm \$2.50; Xerox \$7.20. 152 pages.

THE EFFECT ON RESISTANCE TO
DESEGREGATION IN SELECTED
COMMUNITIES OF A TENDENCY
TOWARD A CULTURAL STATUS QUO AS
IDENTIFIED BY GIVEN CHARACTERISTICS

(L. C. Card No. Mic 60-1319)

Milburn Wingo Blanton, Ed.D. University of Arkansas, 1960

Major Professor: Dr. R. M. Roelfs

THE PROBLEM

The purpose of this investigation was to ascertain the relationship between the cultural status quo tendency of given communities and their resistance to desegregating their public schools.

THE PROCEDURES

Treatment of the Problem.

In this study six communities were selected which had desegregated their public schools, three of which had encountered resistance to desegregation and three which had not. These communities were compared by pairs and by two groups of three each. One community in each pair had encountered resistance to desegregation and the other had not. The group of three communities which had experienced no resistance to desegregation was compared with the other group of three in which resistance to desegregation had occurred.

In pairing and grouping the communities, the total number of pupils involved in the initial desegregation, the proportion of Negro to white pupils, and the size of the communities were considered.

Areas of Comparison. Certain factors were used as a frame of reference in comparing the communities in the investigation of the problem. These factors were the: (1) occupational level of parents, (2) generations of family history in the community, (3) proportion of parents living in separate communities at the time they were married, (4) proportion of fathers who made homes in new communities after returning from service in the armed forces or in defense plants, (5) amount of pleasure travel by families out of state, (6) educational level of parents, (7) proportion of solid color automobiles in the communities, (8) per cent of women voting in state and national elections, (9) number of daily newspapers and magazines in the homes, (10) recreational activities of fathers, (11) number of religious groups represented in the community, and (12) proportion of parents not belonging to any religious organization.

Obtaining Data. Data on the above twelve factors were obtained from responses to two questionnaires—one personally administered to ninth grade pupils in each of the schools of the six communities in the study, and information on the other obtained from personal interviews with the principals and/or superintendents of the six schools.

THE FINDINGS

Those communities which encountered no resistance to desegregation ranked significantly higher at the .05 level

of confidence in the following areas than those in which resistance occurred:

- 1. Level of education of parents.
- 2. Occupational status of parents.
- 3. Mothers voting in state or national elections.
- 4. Fathers participating in three of the five new activities
- 5. Fathers not participating in two of the seven old activities.

Although not statistically significant these same communities also had, (1) a greater proportion of fathers participating in the other two new activities, (2) less fathers participating in four of the five remaining old activities, and (3) a higher proportion of multi-colored automobiles.

No community which encountered resistance to desegregation ranked above its paired community in more than one area.

THE CONCLUSIONS

By grouped communities and at the .05 level of confidence there is a positive relationship between the accepance of desegregation without opposition of communities of this study and the following cultural factors:

- 1. High occupational status of parents.
- 2. College attendance of parents.
- Fathers participating in bowling, bridge, and watching college football.
- Fathers not participating in night hunting and bank fishing.
- 5. Mothers born in a county other than that of present residence.
- 6. Fathers or mothers attending high school.
- 7. Mothers voting in state or national elections. The factor of mothers living in other communities has a negative relationship to the acceptance of desegregation without opposition in the communities of this study. This relationship is significant at the .05 level.

Microfilm \$2.65; Xerox \$9.25. 201 pages.

THE DUTIES AND PROFESSIONAL
ACTIVITIES OF ELEMENTARY SUPERVISORS
IN THIRD AND FOURTH CLASS SCHOOL
DISTRICTS OF PENNSYLVANIA

(L. C. Card No. Mic 60-1328)

Lawrence Buck Derickson, Ed.D. University of Pittsburgh, 1959

The purpose of this study was to determine the types of duties and the various activities of elementary supervisors in the state of Pennsylvania. Supervisor, as the term is used, refers to one in charge of the elementary schools of a system under a school head, in Pennsylvania, known as a "Superintendent" or a "Supervising Principal". The basic elements of the study were: (1) general information about the supervisors and their school systems,

- (2) supervisory activities of the elementary supervisors,
- (3) administrative activities of the supervisors, and
- (4) certification requirements for an elementary supervisor in Pennsylvania compared with those found in six

other fairly comparable states. In elements "2" and "3" information was obtained not only in regard to the number of supervisors in the study performing activities in various areas, but also the extent to which such performance depended upon direction from their chief administrators. Again, in "2" and "3" data were gathered concerning both the extent to which the activities were independent or cooperative and the comparative amounts of time given to the various activities.

The study was delimited to the elementary supervisors in third- and fourth-class districts of Pennsylvania during the 1957-1958 school year. Thus, the study included districts with a population of 30,000 or less. The six states, whose certification requirements for elementary supervisors were compared with those of Pennsylvania, were selected because their current expenditures per pupil were comparable in the school year 1956-1957.

A questionnaire was constructed following a study of appropriate literature and consultation with 12 elementary supervisors. Superintendents and supervising principals aided in transmittal of the questionnaires to the elementary supervisors. Replies were compiled from 240 supervisors, which represented 80 per cent of the persons holding the position studied.

FINDINGS

Most of the 240 supervisors included in the survey were line officers having fairly complete responsibility for the administration and supervision of the elementary schools of their administrative units. Seventy-eight per cent of the supervisors worked for jointures or union districts. The average supervisor in 1957-58 worked 10 or 11 months, received a salary of \$6,428, served five buildings, had a staff of 33 teachers, and had 1,055 pupils enrolled in his elementary system. One hundred sixty-four had the Elementary Principal's certificate; 123, the Supervising Principal's; 64, the Secondary Principal's; and 44, only teaching certificates. The supervisor's degrees were: Doctor's, 14; Master's, 196; Bachelor's, 20; and no degree, 10. The most common title was "Elementary Supervisor", followed by "Elementary Principal" and "Director of Elementary Education". The supervisors were almost unanimous in the opinion that the state of Pennsylvania should mandate a certificate for the position of Elementary Supervisor.

Thirty-four specific supervisory activities were performed by at least half of the supervisors, many of these by as high as 85 per cent or more of the respondents. There was indication that a good majority of the supervisors performed the activities on their own initiative. A good majority of the activities were performed cooperatively with staff members, although there was some indication that the teachers were not involved as frequently as they probably should have been.

The supervisors participated in 37 administrative activities to a smaller degree than they did in the case of supervisory ones. There was indication that many were devoting time to administrative activities which might better have been given to supervision.

Of the six states which were compared with Pennsylvania in regard to certification requirements, four (Illinois, Minnesota, Montana, and Wisconsin) require a specific certificate for a person to be an Elementary Supervisor.

Microfilm \$2.50; Xerox \$7.00. 147 pages.

A STUDY OF THE INFLUENCE OF ADMINISTRATIVE LEADERSHIP UPON EDUCATIONAL CHANGE IN SUPERVISORY DISTRICT 2, LEWIS COUNTY, NEW YORK, FROM SEPTEMBER, 1951 TO JUNE, 1953.

(L. C. Card No. Mic 59-2679)

Donald Thomas Donley, Ed.D. Syracuse University, 1959

This study is an attempt to analyze an ongoing supervisory project, within a supervisory district in order to (1) identify and measure internal changes, (2) gain insights and develop hypotheses concerning change, (3) evaluate the influence of agents having some responsibility for the conduct of the project, and (4) explore the action implications for other schools and personnel. The project was locally designated as an action research project but lacked provision for evaluation.

The project was launched in September, 1951, under the aegis of the Middle Atlantic Region of the Cooperative Program in Educational Administration. The purpose was consciously to improve educational administration and practice and, thereby, instruction. A group of university professors was involved in the improvement process as an advisory committee.

The procedures used in the study were a sequentially evolving series, representing one solution to the problem of analyzing an ongoing "action research" project, itself evolutionary in nature. The selection of procedures which will accumulate data retroactively as well as currently, for the purposes of comparison, is one of the major problems of a study of this type. The procedures included:

- Informal interviews with key personnel to identify perceived changes and to gain suggestions as to other sources of data
- 2. Study of all available records to verify informal interview results and to aid in reconstructing the initial situation.
- 3. Preliminary development of hypotheses regarding change in the situation under study, to be modified on the basis of data accumulated during the remainder of the study.
- Formal interviews, non-structured and structured, used with a carefully selected sample to verify data gathered through previous procedures and to probe for additional items of change and causes of change.
- Staff questionnaires based on formal interview findings and designed to test the validity of the formal interview sample by collecting total staff opinions.
- Typescript analysis, a jury analysis of comments expressed in a random selection of typescripts of principals' meetings during the two year period of the project, to identify changes in verbal behavior of local administrators.
- 7. Advisory group questionnaires, open-ended questionnaires administered to the advisory group of university professors to support or refute findings collected through other procedures, and to collect advisory group opinions as to their own role as an agent of change.

 Administrator questionnaires, open-ended questionnaires parallel to the advisory group questionnaires and administered to establish a comparison with advisory group questionnaire findings.

Where possible, relationship between findings was established by using the rank difference correlation statistical technique. Otherwise comparisons were made by observation and inspection.

There was evidence of change in several aspects of the school operation: philosophy, frequency and nature of professional meetings, relationships among individuals, school program, contact with administrators, amount and kinds of pupil personnel and special services, student and teacher responsibility, interschool relationships, teaching methods, professional and personal insights and attitudes, and administrative practices.

Conclusions drawn from the study indicate that the project under study did effect several changes, that the administrative leadership in the district was the major instrument and cause of change, and that certain conditioning factors and agents existed. In regard to effectiveness of change agents and implications for other schools interested in change it can be hypothesized from this study that kind, degree, and speed of change are functions of:

- the communication, perception, cooperation and developing identity of participating school districts,
- the professional orientation and practices of administrative leadership,
- 3. the sharing of responsibility for decision-making,
- the quantity and quality of professional-personal contact,
- 5. the utilization of a change agent, and
- the kind of utilization and involvement of advisory and/or consultant assistance.

Microfilm \$4.05; Xerox \$14.20. 313 pages.

A STUDY OF PUBLIC SCHOOL FINANCE IN THE SOUTHERN APPALACHIAN REGION

(L. C. Card No. Mic 59-6279)

Archie Reece Dykes, Ed.D. The University of Tennessee, 1959

Major Professor: Orin B. Graff

This study was directed toward an investigation and analysis of various aspects of public school finance in the Southern Appalachian Region with emphasis on trends in public school revenues and expenditures. The major problem was divided into five sub-problems. These were: (1) to review the general demographic and economic trends of the Southern Appalachian Region, (2) to assay recent developments in school finance in the Region toward the end of determining trends in local, state, and Federal contributions to public school revenues and trends in expenditures for budget items of instruction, capital outlay, and current expense, (3) to analyze efforts to support education as indicated by public school revenues in terms of the

economic ability of the Region as measured by personal income, (4) to analyze the level of school support in metropolitan school systems, school systems with increasing school populations, school systems with static school populations, and school systems with decreasing school populations, and (5) to draw conclusions and state implications for the administration of education in the Region.

The study was limited to a selected sample of school systems and the period of time from 1939-40 to 1957-58. The study was further restricted to revenues for public elementary and secondary schools and expenditures for budget items of instruction, current expense, and capital outlay.

Two principal methods of research were used to achieve the purpose of the study. In reviewing the general economic and demographic changes and trends in the Southern Appalachian Region, which constituted the first step toward the achievement of the purpose of the study, the historical method was utilized. The goal here was to provide a setting and background information which would contribute to an understanding of public school finance in relation to the social and economic forces of the Region. In order to accomplish the remaining steps, namely, assaying recent developments in school finance with emphasis on changes, analyzing efforts to support education and analyzing the level of support, the normative-survey method of research was employed.

Data were gathered from the work of sociologists and economists working on other phases of the Southern Appalachian Studies, from census reports, from annual and biennial reports of State Departments of Education, from publications of the United States Office of Education and the National Education Association, from local school systems, and from "Survey of Buying Power," Sales Management.

Findings

The major findings of the study fell into four major areas. They are here synthesized and presented accordingly.

Changes in the Sources of School Revenues

The major trend in school revenues during the period under study was the decreasing importance of local contributions. Although school revenues raised from all sources increased rapidly, the percentage raised from local sources decreased.

Revenues coming from Federal sources had greater percentage increases than funds from state sources, but Federal sources were contributing only a small portion of the total revenues at the close of the period under study.

Changes in School Expenditures

The period under study was a time of rapidly increasing school expenditures. Increases of three or more times in the budget items covered were common. Increased revenues were making possible a larger percentage of current expense for budget items other than instruction.

Except for the budget item of capital outlay, the rate of increase in per pupil expenditures was greater during the last eight years of the period than in the first ten. This was indicative of an accelerating rate of increase expenditures for instruction and current expense.

Changes in Educational Effort and Economic Ability

The period under study was a time of rapidly rising economic ability and of decreasing educational effort in all classifications of school systems except metropolitan. Economic ability, as measured by per capita income, more than quadrupled during the period under study. However, increases in income-ability were not matched by increases in school support.

Trends in the Level of School Support

In the level of school support increased rapidly during the period. However, the level of support increased at a slower rate than did ability. The increases in the level of support was far from uniform. School systems with the highest rate of increase in ability were supporting their schools at the lowest level at the close of the period.

Microfilm \$3.70; Xerox \$12.85. 285 pages.

THE PROFESSIONAL STATUS OF TEACHERS IN THE SOUTHERN APPALACHIAN REGION

(L. C. Card No. Mic 59-6281)

William Lyle Evernden, Ed.D. The University of Tennessee, 1959

Major Professor: Orin B. Graff

The problem in this study was to investigate, analyze, and assess the progress made toward the development of a teaching profession in the Southern Appalachian Region. The study encompassed the following sub-problems: (1) To develop criteria against which the degree of professionalization of teachers could be measured, and to gather information about the professional characteristics of teachers in the Region pertinent to the developed criteria of professionalization; (2) To analyze information dealing with certain of the developed criteria of professionalization for selected teachers and for selected counties in the Region and to compare it with similar data available on a state-wide and a nation-wide basis; (3) To investigate the part played by teachers' professional organizations within the Region, and their place in the development of a profession of teaching; and (4) to appraise the findings of the study and to indicate their implications for the professional development of teachers in the Southern Appalachian Region and for the administration of education in the Southern Appalachian Region.

The procedures employed in the study included three principal methods of research. In determining the background factors which set the stage for the present professional level of teachers in the Region, the historical method was utilized.

The normative-survey method provided the data on which the assessment of the current state of the teaching profession was based. This included visits to nineteen selected school systems, interviews, correspondence, questionnaires, searches of county and state department records, and a study of the publications of the state departments and state and national professional organizations.

Final comparisons, analyses, and tabulations of data employed the statistical method of research.

Analyses of the data revealed a number of pertinent facts concerning the teachers of the Region. A summary of representative findings follows.

Teachers in the Region met the requirements of adequacy of training with two exceptions: (a) In 1959, 18.9 per cent of the sample still had not completed college graduation. (b) The percentage of teachers with specialized graduate professional training was almost 10 per cent lower than the national average.

Teachers in the Region worked approximately 25 per cent more hours per week than the currently accepted industrial work-week, in order to do the job which needed to be done.

Teachers fell short of meeting the criterion which defined a profession as a vocation offering practitioners a life career and a permanent membership.

Teachers adequately met the criterion requiring continuous in-service growth, when this growth was measured in terms of professional reading and travel. They failed to meet the criterion with respect to completion of college courses and participation in formal programs of in-service education.

Teachers in the Region were generally aware of the social function of their profession. Their morale, however, was not high. This failure to meet the social function criterion with respect to their own attitudes toward themselves and their profession was directly related to low level of remuneration and low status of public esteem. Teachers in the Region were not paid professional salaries. Although salaries had more than doubled in actual purchasing value in the preceding thirty years, they were still significantly below the national average, and even further below a sound professional level.

Teachers in the Region maintained professional organizations which were self-governing in that they had constitutions, elected officers, and conducted programs. They were not truly self-governing in the way a professional organization must be. That is, they did not in any way govern their membership. Membership and active participation were not at the desirable 100 per cent level.

Every professional education association in the Region had and subscribed to a code of professional ethics. These codes of ethics were apparently not enforced, nor did the machinery seem to be present for their enforcement. This meant, in effect, that only those members who were personally professional had a code of ethics.

Microfilm \$3.35; Xerox \$16.20. 258 pages.

ROLE PLAYING AS A MEANS OF SELECTING ADMINISTRATORS

(L. C. Card No. Mic 59-6282)

Charles Warren Hartsell, Ed.D. The University of Tennessee, 1959

Major Professor: Galen N. Drewry

The basic aim of this study was to find a short, effective means of selecting school administrative personnel through the use of role playing. Two hypotheses were made:

(1) Role playing situations could be developed which would reveal basic behavioral characteristics of school administrators, and (2) There would be no significant difference in judge's ratings made in role situations and ratings made while the administrators were actually on the job.

The criterion with which the role playing situations were to be compared was the Tenessee Rating Guide, a

rating instrument which had been validated previously at the University of Tennessee. The four role playing situations used in the study were selected from a number which were tried on a pre-experimental basis, and which, in the opinion of competent judges, would elicit behavior similar to that which is measured and evaluated on the Tennessee Rating Guide.

Subjects included twenty-five male graduate students in the University of Tennessee College of Education, all of whom had at least five years of experience in the field of education. Approximately half of the group was composed of individuals who were, at the time of this study, full time administrators completing work toward advanced degrees.

The panel of judges was made up of doctoral students and staff members of the College of Education, all of whom had experience in using the Rating Guide. Three judges participated in the role playing sessions, and a final composite rating on each subject was made up from the individual ratings completed by each judge. A different panel of three trained judges as selected and, several months after the role playing sessions were completed, rated each of the subjects while he (the subject) was actually on the job. These field ratings involved observation plus an interview.

Analysis of the data showed that the first hypothesis was substantiated. That is, the role playing situations developed were significantly correlated with behavioral characteristics as measured on the Tennessee Rating Guide. The second hypothesis, that there would be no significant difference between ratings made during role playing sessions and ratings made in the field was not substantiated. None of the correlations was significant. Therefore, the basic aim of the study was not realized.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

ORGANIZATIONAL AND ADMINISTRATIVE ADJUSTMENTS FOR EFFECTIVE ELEMENTARY SCHOOL UTILIZATION OF IN-SCHOOL TELECASTS

(L. C. Card No. Mic 60-1539)

Caryl G. Hedden, Ed.D. The University of Buffalo, 1960

First Adviser: Dr. A. J. Penn

Hypotheses

This study investigated the hypothesis that the use of educational television as an instructional tool in the elementary school creates certain administrative and organizational problems for the elementary school principal which have to be solved in order to make such use effective. The related hypotheses assume that the use of educational television as an effective instructional tool requires:

- Orientation and in-service education programs for the teachers whose classes will be using televised instruction.
- Some definite preparation of the pupils who are expected to learn from it.

- Adjustments in the organizing and scheduling of classes for viewing.
- 4. Adjustments in regard to physical facilities and equipment.

Purposes

The specific purposes of the study were defined as follows:

- To determine as background information the extent of television curriculum offerings being presented by selected educational television stations for inschool viewing by pupils of kindergarten through grade six, and to ascertain the characteristics of the programming in regard to grade levels, content, duration and frequency.
- 2. To determine if the assumptions as stated in the hypotheses are confirmed as they relate to the effective use of these educational television programs in elementary schools.
- 3. To determine and recommend possible administrative procedures for principals to follow in attempting to make effective use of in-school telecasts.

Significance of the Study

This study is considered to have importance because this is an area of investigation where very little research has been conducted. There has been a growing use of ETV in elementary schools since 1953 when the first ETV station went on-the-air, but there has been little or no study or reporting on the administrative and organizational aspects of such use. The data provided by this study may serve as a resource for a practical guide for school systems undertaking the use of educational television as an instructional tool in their elementary schools.

Plan of the Study

To obtain data to achieve the purposes of the study, the writer sent a questionnaire to 122 elementary school principals whose schools were directly involved in the use of the in-school programming of nine selected ETV stations which had been on-the-air three years or more. Responses were obtained from 112 or 91.8% of the principals and these responses were analyzed as the basic source of data.

In addition, the writer secured and analyzed programming information from the nine ETV stations selected in order to determine what was available for use in kindergarten through grade six classrooms.

Conclusions

The writer felt that the evidence found confirmed the hypotheses. Considerable programming was found to be available for use in the elementary schools—chiefly of an enrichment nature—and these programs were utilized to varying extent by approximately 50% of the potential pupil audience. The largest number of classes viewed only one program per week (39%); only 4.5% saw more than five programs a week.

Principals' responses indicated that organizational and administrative adjustments were required in regard to:

- 1. Orientation and in-service education of teachers
- 2. Preparation of pupils for learning from television
- 3. Organizing and scheduling classes for viewing
- 4. Physical facilities and equipment

Based upon the evidence found, numerous recommendations are made by the writer concerning procedures to be followed in making the necessary adjustments for the effective use of educational television as an instructional tool in the elementary school.

Suggestions are made for further study in seeking to make television an effective teaching tool.

Microfilm \$2.50; Xerox \$7.00. 147 pages.

AN ANALYSIS AND APPRAISAL OF SELECTED ASPECTS OF THE SUMMER ENRICHMENT PROGRAM IN THE PUBLIC SCHOOLS OF FLORIDA

(L. C. Card No. Mic 60-1331)

Charles Edward Hirshey, Ed.D. University of Pittsburgh, 1959

The purpose of this study was to analyze the status of selected aspects of the summer enrichment program in the public schools of Florida and to appraise the practices in the program by application of evaluative criteria established by a national jury of experts. A six-page questionnaire was developed to serve as a research tool which was sent to 1728 teachers, supervisors, and administrators in 55 counties. Supplemental data were obtained through interviews and from reports filed with the state department of education by the county superintendents of public instruction.

Twenty-five leaders in education and recreation served as judges for the purpose of ascertaining the desirable criteria. The instrument was patterned after the questionnaire used in making the main survey. The data obtained in the questionnaire were appraised in the light of the validated criteria.

Findings in the study showed that recreation was the core of the summer enrichment program in the public schools of Florida. Reading, library activities, and other cultural activities were not well developed to provide those experiences which are not normally received during the regular school year. Personnel were found to be well qualified for the recreation program from the standpoint of training and experience. Administrative practices pertaining to the existing program were appraised as satisfactory though some administrative personnel were found to utilize part of their time on normal school administrative duties.

A well-rounded program of recreational activities was offered to the 326,347 white registrants in the 1958 program in most counties except for adults where an inadequate program was found. Sports and games, arts and crafts, and swimming were the predominating types of activities. Playgrounds, swimming facilities of various

types, and gymnasia were the most common types of facilities utilized. Many of the libraries were not open for use in the program. Community planning with other agencies whose programs were directed toward the service of children, youth, and adults was evidenced.

It was concluded in this study that a good recreational program was available for the children and youth in Florida through the public schools considering the personnel, administration and organization, program of activities, and the facilities. There is need for expansion of the program in order to provide more of the activities which could be offered to enrich the regular school year program as intended by the legislature in 1947. Local financing must be made available as a supplement to state aid and school bus transportation should be made available to those who cannot avail themselves of the program because of the lack of other means of transportation and long distances involved in most counties outside of metropolitan centers.

Consideration should be given to the adoption of a plan whereby academic courses of remedial and accelerated types would become an important phase of the enrichment program. The adult program should be expanded to meet the needs of the older people where no such plans are sponsored by other agencies.

Microfilm \$2.50; Xerox \$8.60. 188 pages.

EXPERIENCE-CENTERED LEARNING ACTIVITIES AND ATTITUDES TOWARD SCHOOL AND PEOPLE

(L. C. Card No. Mic 60-1526)

Mabrey Lee Miller, Ed.D.
The University of Nebraska Teachers College, 1960

Advisers: Dr. Walter K. Beggs Dr. Dale K. Hayes

Statement of the Problem

The problem of this study was to determine the relationship between the introduction of experience-centered learning activities into science and social studies classes and the development of positive attitudes toward the school and people.

Procedures

The study was an integral part of the Curriculum Experiment phase of the Nebraska Community Education Project (NCEP). Staff members of the NCEP provided leadership for the formation of a study committee (SC-2) composed of personnel from the Nebraska State Department of Education and the University of Nebraska Teachers College. The study committee met regularly for a two year period to form policy and provide leadership for the curriculum experiment.

A pilot study, of one semester duration, was instigated to discover methods of working with teachers, to encourage the use of experience-centered learning situations and to design and revise methods of evaluating results. The pilot study, which followed some months of study by SC-2

and meetings with teachers from the four centers of the NCEP, was carried on during the second semester of the 1957-58 school year.

During the summer following the pilot study, workshops and conferences were held to make plans for the ex-

perimental year approaching.

At the beginning of the 1958-59 school year, an evaluative questionnaire was administered to the students in grades three through twelve of the public schools of the four towns in the NCEP and of two towns which were chosen as controls. The science and social studies teachers in the four experimental towns were encouraged to increase their use of experience-centered teaching practices. The increase of these practices was encouraged by local school administrators, by visits from members of SC-2, by letters which members of SC-2 wrote to experimenting teachers in response to monthly reports submitted by the teachers, by a monthly newsletter composed by the NCEP staff, by exchanges of information between the centers concerning hopeful practices, and by conferences where teachers met together to exchange ideas and hear consultants speak. At the close of the school year the evaluative questionnaire was readministered.

A sample of 600 experimental students and 600 control students was selected. The spring and fall answers given on the evaluative questionnaire were paired and the data were treated statistically to determine the results.

Conclusions

Students prefer classes in which experience-centered teaching methods are employed over those classes in which experience-centered teaching methods are not employed.

Students will say their preference for favorite classes is because of experience-centered learning activities.

Students build more relationships with other students who are participating with them in experience-centered learning activities.

Students participating in experience-centered activities which include wise use of community resources and community improvement projects show definite growth in their preference for higher level experience-centered activities as things they like to do best in school.

High school students build better relations with secondary school teachers who are employing experience-

centered teaching methods.

Elementary students who participate in experiencecentered learning activities understand better their reasons for going to school. However, high school students who are participating in experience-centered learning activities understand no better their reasons for going to school.

No evidence was found to indicate that students who participated in experience-centered activities feel that they learn more or that they become more concerned about the community.

Microfilm \$4.75; Xerox \$16.90. 371 pages.

THE RELATIONSHIP BETWEEN SEVERAL SELECTED FACTORS AND SUCCESS IN GRADUATE STUDY IN EDUCATION

(L. C. Card No. Mic 60-1341)

Richard Voight Nuttall, Jr., Ph.D. University of Pittsburgh, 1959

Supervisor: V. C. Lingren

The purpose of the study was to determine by correlation what relationship existed between several selected factors and success in graduate study as measured by quality point average.

The data were gathered from the Office of Graduate Study, School of Education at the University of Pittsburgh. The sample population included all of the 265 students who received their Master of Education Degree during the cal-

endar year 1958.

The factors which were related to success in graduate study were: the undergraduate over-all quality-point average, the undergraduate quality-point average in mathematics, English, and modern languages, the ages at the time of receipt of the bachelor's degree and the master's degree as well as the difference between these two, and the University of Pittsburgh Examination for Graduate Students which is made up of three subtests in analogies, mathematics, and reading comprehension. In all statistical calculations the data were broken down to include each of several selected undergraduate schools as well as the entire sample.

It was found that age had no marked effect on graduate quality—point average and that the University of Pittsburgh Examination for Graduate Students was a better predictor of success in graduate study than the undergraduate quality—point average when a multiple coefficient of correlation was used. Microfilm \$2.50; Xerox \$5.20. 102 pages.

A STUDY OF THE IN-SERVICE EDUCATION PROGRAM IN THE WESTSIDE COMMUNITY (NEBRASKA) SCHOOLS

(L. C. Card No. Mic 60-1527)

Glenn E. Pickrel, Ed.D. The University of Nebraska Teachers College, 1960

Adviser: Merle Arden Stoneman, Ph.D.

Statement of the Problem

The purpose of this study was to analyze and appraise the development, organization, purposes, basic activities and evaluation techniques of the in-service education program of the Westside Community Schools. It was deemed necessary to determine some of the contributions of this in-service program to (a) professional growth and development of the participants, and (b) the improvement of the instructional program.

Procedures

To evaluate the in-service program of the Westside Community Schools the procedure took the form of a group case study. A study was made of the literature which reported the experimentation and accomplishments in the field of in-service education over the past two decades. The study of the literature resulted in the development of general principles which were used as criteria in appraising the Westside program.

The study was developed by (1) describing the school system and the community in which the study took place, (2) a report of the growth of the in-service program in the Westside Community Schools as it unfolded over the four-year period of the study, (3) the discovery of contributions of the in-service program to the professional growth of the teaching staff and to the improvement of the instructional program, and (4) presenting implications for the improvement of the in-service program based on the foregoing critical analysis and appraisal.

The study of the literature produced a set of guiding principles from which a questionnaire was developed. This questionnaire was submitted to a selected group of teachers. The information gleaned from the questionnaire helped to appraise the effect of the in-service program on the participating personnel. The effect of the in-service program on the instructional program was appraised by reviewing the results of the testing program used by the Westside Community Schools.

Findings

The purposes and activities of the in-service program have increased in strength and quality. The planning has been increasingly centered around problems of significance and concern to teachers. The organization has been flexible. The teachers have grown professionally. Among such changes noted in teachers are the increased ability (1) to provide individual differences, (2) to plan and work together, (3) to use instructional material, (4) to use the group process, (5) to help make the school more democratic. These are in harmony with the principles of effective in-service programs.

The instructional program has improved. Some significant improvements are (1) many practical classroom procedures have been developed and shared, (2) curriculum materials have been improved, (3) more individualized instruction has resulted, (4) ability grouping and curriculum materials for such groups have been developed, and (5) there was evidence of a great deal of growth in skills and other areas of achievement.

Recommendations

Based upon this study the writer would make the following recommendations for the improvement of the inservice program for the Westside Community Schools:

- 1. Teachers who are new to the system should be given a more thorough introduction to the in-service program and the roles they will be expected to play.
- 2. The principles of continuous evaluation should be rigorously employed.
- 3. More time for cooperative planning and evaluation should be provided in the future.
- 4. Consultants from other disciplines should be provided as needed in the future.
- 5. Attention should be given to the continued use of the services that can be provided by the Teachers College of the University of Nebraska.

- 6. The leadership should take steps to place emphasis on the teacher orientation segment of the in-service program.
- 7. The leadership should take steps to insure more lay and parent participation in the in-service activities.
- 8. More consideration should be given to the focusing of in-service activities into action research projects.
- 9. The leadership should give more attention to a critical, objective analysis of the effects of the in-service program on the individual teacher.

Microfilm \$2.55; Xerox \$9.00. 196 pages.

RECRUITMENT, SELECTION, AND APPOINTMENT OF TEACHERS IN IOWA SCHOOL SYSTEMS HAVING AN ENROLLMENT IN EXCESS OF 700.

(L. C. Card No. Mic 58-1239)

Lawrence Henry Shepoiser, Ed.D. University of Colorado, 1957

Supervisor: Professor Calvin Grieder

The primary purpose of this study was to survey the policies and administrative procedures observed in the recruitment, selection, and appointment of teachers in selected Iowa school systems.

Data were obtained through the cooperation of the superintendents of schools in 106 Iowa school systems, each system having a total pupil enrollment in excess of 700.

The questionnaire was designed to secure from the superintendents surveyed a response as to the use and extent of certain practices and policies in the recruitment, selection, and appointment of teachers, and, in addition, an estimate of the value of the same policies and practices. There was 100 per cent return on the questionnaire.

The principles or practices that were found to be most helpful in the selection of teachers were:

- 1. Prepare a written statement of procedure of teacher selection and appointment.
- 2. Establish specifications and qualifications for all positions.
- 3. Keep an up-to-date inventory and analysis of the composition of the faculty.
- Publicize the eligibility requirements for appointment.
- Keep the placement offices informed as to the progress of filling a vacancy.
- 6. Make use of faculty and lay participation in the selection and appointment procedures.
- 7. Make use of school-developed application forms.
- 8. Respect the teacher's preference in appointment for a specific position.
- 9. Take at least thirty minutes to conduct a comprehensive interview.

- 10. Budget a definite amount of money to be used in the selection of teachers.
- 11. Recommend only election to the board of education only one candidate at a time for each vacancy.

Conclusions from this study include the following:
Very few Iowa school systems had established a welldefined program of recruitment, selection, and appointment
of teachers, as evidenced by the fact that there were few
written policies and procedures. Factors other than size
appeared to be reasons for school systems having adopted
written policies recommended by authorities in the field
of school administration.

Responsibility for improving procedures in teacher selection lies primarily with the superintendent of schools through leadership of the board of education. If training standards for certification are to be raised, the Iowa State Department of Public Instruction must take the initiative. College placement bureaus have an opportunity for outstanding professional service to both the applicant and the school system in the selection process. Superintendents of schools did not use any one method exclusively in locating candidates. Each recommended practice in teacher selection was found in some form in at least one Iowa school system. There is a need for superintendents of schools to receive some specialized training at the graduate level in the skills and techniques of teacher selection.

On the basis of the findings reported in this study, and of the conclusions reached, it is recommended that: (1) The graduate curricula for school administration should require two or three semester hours of credit in a course designed to assist the superintendent of schools in developing policies and techniques in the recruitment, selection, and appointment of teachers. (2) College placement offices should be encouraged to expand their services. (3) More attention should be given to the topic of personnel administration at professional meetings. (4) A school system with 250 teachers or more should employ a full-time assistant in charge of personnel administration. (5) The Iowa State Department of Public Instruction should raise the standard of preparation for certification of all teachers to a minimum of a baccalaureate degree. (6) Each school system should have cooperatively developed and widely distributed policies on recruitment, selection, and appointment of teachers. Microfilm \$5.20; Xerox \$18.45. 408 pages.

A STUDY OF OPINIONS CONCERNING THE PROFESSIONAL PREPARATION OF EDUCATIONAL ADMINISTRATORS FOR COMMUNITY EDUCATION

(L. C. Card No. Mic 60-1528)

Robert James Stalcup, Ed.D.
The University of Nebraska Teachers College, 1960

Adviser: Dr. Dale K. Hayes

Statement of the Problem

The purpose of this study is to determine what, in the opinion of selected leaders in education, should be provided in the professional preparation of educational administrators for effective work in community education.

Procedures

The related literature was reviewed to (1) identify educational administrators who have had or now have leadership roles in community education, (2) identify strengths and weaknesses in programs of professional preparation relative to preparing educational administrators for community education and (3) provide a basis for constructing an opinionnaire which would be mailed to the educational leaders identified in the literature.

Personal interviews were given to fourteen of the eighteen selected educational leaders who are not now public school administrators. Data from the interviews and the literature were used to prepare the opinionnaire which was mailed to two groups of seventy-three respondents -- Group I made up of eighteen educational leaders not in public school administration and Group II consisting of fifty-five superintendents in the field. A return of seventy-eight per cent was realized.

The returned opinionnaires were analyzed to ascertain general areas of agreement and disagreement between the two groups of respondents.

Findings

Both groups agree that preparation programs for community education should provide work in Community Processes, Community Economics, Community Organization and Human Relations. The respondents also agree that field experiences closely related to and correlated with these courses are important.

These two groups of educators also agree that School Law, Psychology, Anthropology, Political Science, Educational Psychology and Curriculum are of little value in preparing for community education. Continuing post-doctorate work is not endorsed by either group. Especially significant is the fact that the respondents overwhelmingly believe that current preparation programs for educational administrators do not prepare them for community education.

Internship Seminars, Social Psychology, Public Speaking and Inter-disciplinary Seminars are areas about which there is some disagreement. Group I respondents strongly favor the first, second and fourth items while Group II respondents feel they are of limited value. Public Speaking, considered very important by superintendents, receives little support from Group I.

Conclusions

To work effectively in community education an educational administrator needs certain competencies. These competencies are not being developed in present preparation programs. Preparation programs for community education should emphasize work in the areas of human relations and community processes.

Recommendations

- 1. Preparation programs should be revamped to allow selected students to train specifically for community education.
- 2. Advisory programs should be itensified so that only the best qualified students are accepted and their training based on their strengths and weaknesses.

- 3. Schools should be required to meet certain requirements in order to confer advance degrees in educational administration. Such requirements would be suggested by a committee appointed by some national organization of educators.
- 4. Carefully planned field experiences should be made available to students who could benefit from them. Such field experiences should progress from observation to participation to leadership and should be coordinated with educational theory.
- 5. Faculties of graduate schools preparing educational administrators should be made up in part of people who have received training in areas other than professional education.
- 6. Preparation programs should emphasize work in human relations and community processes.
- 7. A restriction should be placed on the number of hours earned in summer sessions which can be applied toward an advanced degree, making possible a higher degree of continuity in the program.
- 8. Educational administrators should be made to see the desirability of continuing education even beyond the doctorate.
- 9. Further studies should be made to determine the best means to implement a program designed specifically to prepare educational administrators for community education.

 Microfilm \$2.50; Xerox \$5.20. 101 pages.

A SCALE DESIGNED TO ASSESS THE RELATIVE IMPORTANCE OF SCHOOL BOARD PRACTICES

(L. C. Card No. Mic 60-1324)

James H. Timmons, Ed.D. University of Arkansas, 1960

Major Professor: Dr. Roy B. Allen

The purpose of this study was to develop a scale for assessing the relative importance of school board practices.

The procedure employed in the development of this scale was the well-recognized method of scale construction known as the method of equal-appearing intervals described by Thurstone and Chave.*

One hundred fifty practices commonly employed by school boards were submitted to 100 professors of educational administration in 37 states. These professors were asked to sort all 150 practices into 11 piles which appeared equally spaced to them personally on a continuum which ran from "most important" to "least important." That is, the hypothesized continuum was "importance of school board practices."

The criterion for judging the quality of practices for the scale was the agreement of the judges (professors) as to location on the 11 interval "importance" continuum. Obviously, if the judges could not agree as to an item's location, the item would be of no value. Three practices having the smallest dispersion (greatest agreement as to location) were selected from each of the 11 intervals. Each practice was then tested for random distribution by Chi-Square. One practice did not test significantly different from having a random distribution at the 1 per cent level of significance. The remaining 32 items form the scale. The scale value of each practice was calculated by determining the median location for the 100 judges.

The modus operandi of a school board may be assessed by checking which of the 32 practices are being employed by the school board. The median of the scale values of those practices checked then serves as the index of quality of operation as defined by the Thurstone-Chave method.

THE SCALE

	THE SCALE
Scale Value	School Board Practice
8.65	The board works and cooperates with com- munity agencies.
7.12	Some staff members attend board meetings as consultants.
6.85	Board members receive copies of leading school board journals.
.50	All board meetings closed to the public.
3.31	Newspaper publicity concerning careers and interests of new board members.
4.31	New board members invited to attend next regularly scheduled meeting of school personnel.
2.20	First board meeting for new members a dinner, luncheon, or social gathering.
10.44	Board delegates administrative functions to the superintendent of schools.
10.39	Superintendent attends all board meetings except when own contract or employment is being discussed.
7.78	Board provides expenses for teachers to attend professional meetings.
8.09	Board has a screening committee to interview candidates for superintendent.
9.96	Board employs competent legal counsel when needed.
6.80	Board encourages community groups to use school facilities.
9.70	Board requires all school personnel and laymen to make requests and complaints dealing with administrative matters to the superintendent.
1.34	New board members asked to address the faculty.
3.50	Occasionally hold dinners or luncheons in conjunction with school board meetings.
5.56	Board members attend study-council meet- ings.
.66	Board members receive financial compen- sation in form of salary.
4.28	Board has joint meetings with other boards.
1.35	Board members admitted to school activities without charge.
2.45	Hold closed board meetings occasionally.
5.25	Board members visit schools outside the district for ideas.
6.89	Current publications dealing with the prac- tices of school administration made avail- able to-all board members.
9.87	Board revises its rules and regulations when needed.
2.47	Board sponsors social affairs for the school

Scale Value	School Board Practice
1.08	New board members given a courtesy cer- tificate.
3.50	Board members hold conferences with visitors from other districts.
4.10	Board receives publications from other schools.
10.31	Board employs and dismisses personnel only on superintendent's recommendations
7.62	Board has liberal welfare policies for all personnel.
.62	Board purchases all school supplies locally regardless of price.
8.45	Board encourages surveys by school staff, accrediting associations, colleges and universities, specialists, state departments, and citizen groups in evaluating the work of the school.
	Microfilm \$2.50; Xerox \$5.00. 100 pages.

*L. L. Thurstone and E. J. Chave, The Measurement of Attitude (Chicago: University of Chicago Press, 1929).

A STUDY OF THE SCHOOL PLANT FACILITIES OF THE UNITED STATES AIR FORCE DEPENDENTS' SCHOOLS IN THE EUROPEAN AND NORTH AFRICAN AREA

(L. C. Card No. Mic 59-6290)

James Karl Umholtz, Jr., Ed.D. The University of Tennessee, 1959

Major Professor: John W. Gilliland

The purpose of this study was to analyze and appraise the school plant facilities of the United States Air Force Dependents' Schools in the European and North African Area. The study was also made (1) to trace the development of attendance centers for the selected Air Force Dependents' Schools, (2) to identify acceptable criteria for evaluation of the school plant facilities, and (3) to determine the adequacy of the physical facilities of the twelve Air Force Dependents' Schools utilizing the criteria identified.

The writer visited in June 1959 each of the twelve selected Air Force Dependents' Schools in Morocco, North Africa, Spain, France and Germany. During the inspection of each school an appraisal was made using a Guide for Evaluating School Buildings. Development of the criteria was made from writings of experts on schoolhouse planning and construction and from a careful study of articles, bulletins, problems, and masters' and doctoral theses about the various aspects of the facilities. Criteria developed were classified as site, building structure, service systems, classrooms and special rooms. The final phase of the study was a comparison of the criteria with the selected schools.

The findings of the investigation seem to warrant the following recommendations:

1. A guide or manual for planning and constructing school plants to be made available through the superintendent of schools. This guide or manual should be used by the local contracting authorities for the development of plans. Overseas architectural firms generally design the physical facilities utilizing local materials. Therefore, it is deemed essential that local planners adhere to criteria on site, building structure, service systems, classrooms and special rooms.

2. That a master plan be developed for each individual attendance center. Such a plan should show the trend in population served and indicate factors that may tend to change the environment of the attendance centers. It should illustrate future expansion of the physical facilities and service systems as needed. A final feature in the master plan should be a limitation for the enrollment of students in any existing physical facility of the attendance center.

3. That a plan be developed for continuous evaluation of the existing physical facilities. This should be used as an argument for discontinuing temporary and semi-permanent building structures, as well as for improving existing facilities.

4. Responsible representatives should develop a plan to be used for developing new attendance centers by analyzing the cost for transported students as compared with a plan for an attendance center where fewer students may be transported.

5. New attendance centers should be planned near dependent housing areas.

6. Play areas should be adequately landscaped and properly maintained.

7. Bus loading zones should be located in an area convenient to students being transported. Departure lanes of the buses should not cross the flow of students.

8. Classrooms need heating and ventilating equipment designed for keeping the air moving and the temperature constantly controlled at seventy-two degrees. Attendance centers in Germany, France, and Spain need American type unit ventilators. Centers in Morocco need individual heating and air-conditioning ventilators, because of the temperature range.

9. Illumination levels should be maintained at fifty foot-candles in regular classrooms. Close work in special classrooms should be maintained at an illumination level of one hundred foot-candles. Classrooms should have decorative paints with the following reflectance ratings: ceilings and drop ceilings, 85 per cent; upper walls, 55 to 70 per cent; wainscoting 40 per cent or more.

10. Increase the number of fountains for those students enrolled. Replace unsanitary or unserviceable fountains.

11. Toilet rooms need to be redecorated in light reflective paints, illumination increased, floors replaced, and floor drains installed in some locations. The number of water closets and urinals needed for students enrolled should be increased so as to conform to the standards for each sex. Wash sinks likewise need to be increased.

12. Additional electrical service outlets should be installed in regular classrooms, special classrooms and special rooms. Dependable program clocks and bells need to be installed in all school plants.

13. All custodians should attend a training program.

14. Dining room facilities and equipment should be improved. Dining rooms should be designed for the convenience and service to the students.

Microfilm \$2.50; Xerox \$8.60. 186 pages.

EDUCATION, ADULT

A DESCRIPTIVE STUDY OF CERTAIN ASPECTS OF THE MEMBERSHIP OF FORMAL ASSOCIATIONS IN A SOUTHERN TOWN

(L. C. Card No. Mic 60-1414)

John S. Newberry, Jr., Ph.D. The Florida State University, 1960

The study describes the relationship of certain structural and functional aspects of the formal associations of Thomasville, Georgia to selected membership characteristics. Analyses of the association between membership variables and associational factors, identified by descriptive techniques, are diagnostic in intent but exploratory in method.

Method.—The study identified 105 associations: (1) conforming to certain criteria for formal associations from the literature; (2) having membership 25% or more comprised of White, adult residents of Thomasville; (3) in operation June 1, 1956. Representatives interviewed provided data on the structure and function of the associations.

A master list was constructed from membership lists provided by 100 associations. A 2,960 square mile area was delineated by the residence of members, within which zones were established by rates of membership and executive officeholding for members living outside Thomasville. The city was subdivided into districts by participation of residents in the 100 associations. Dwelling classes were delineated within Thomasville White residential areas by observation of dwelling characteristics. Relationship of residence to membership and executive officeholding by sex was analyzed for the entire membership. A 197 member stratified sample, of members living within ten miles of Thomasville, was interviewed to provide data on participation and other characteristics. Structural and functional factors found to discriminate among the 105 associations were analyzed in relation to selected membership variables.

Findings.--Patterns of interaction and structural linkage among the associations formed a community associational structure linked to the institutional structure of Thomasville at many points. Two typologies of the associations were developed.

1. Principal function was derived from reports of programs and services [(a) religious, (b) educational, (c) occupational, (d) civic-service, (e) social-fraternal, (f) heritage, (g) veterans]. Principal function was related to operational aspects of function.

2. Primary linkage to other structures [(a) independent, (b) sponsored by a local institution, (c) federated to out-of-area headquarters, (d) satellite of another association, (e) agent of a corporate structure] was more directly related to internal structural characteristics, less directly related to operational aspects of function. Other factors discriminating among the associations included: (1) scores on a composite formalization index, (2) representation on inter-organizational bodies, (3) scope and orientation of activities, (4) cooperation with non-connected associations.

The 100 associations included 3,887 individuals holding 7,296 memberships. An estimated 5% of the 1950 adult, White area population and 40% of Thomasville adult, White population were members. The inverse association between distance of residence from Thomasville and

participation was greater for women than for men. Dwelling class was associated with rate differences in participation for Thomasville residents. The sample was a select group as to age, occupation, education, income, family stage, and length of residence in the area--factors also associated with differences in Chapin Social Participation Scale score.

Principal function predicted the range of membership on selected variables more efficiently than other associational factors studied. Religious associations for women, veterans and social-fraternal associations for men involved the largest number of individuals not reached by other types and the widest range of members on the variables studied. Significant associations between residence and principal function persisted with multiple membership held constant. Size and sex composition of membership acted to limit aspects of structure and function studied.

Interpretation.—Findings were examined in relation to: (1) limitations of the study, (2) characteristics of the area and population, (3) the character of relationships described. The study demonstrated the utility of principal function for establishing a typology of associations meaningfully related both to structural and functional aspects of associations and to member characteristics. Propositions generalized from the findings were presented and some applications suggested.

Microfilm \$5.65; Xerox \$20.05. 444 pages.

A STUDY OF UNIVERSITY OF BUFFALO EVENING COLLEGE STUDENTS RECEIVING THE BACHELOR'S DEGREE, 1952-1958.

(L. C. Card No. Mic 60-1541)

Sanford Jack Zeman, Ed.D. The University of Buffalo, 1960

The purpose of this study was to identify some of the characteristics which are descriptive of the evening college student who earns the bachelor's degree, and to investigate certain other factors which may be related to this endeavor.

Leaders in the field of adult higher education estimate that as few as ten to fifteen per cent of the students who start for a degree in the evening ever obtain one. Although there is frequent mention in the literature of the need to know more about the evening college student, research in this area is not abundant and no reference could be found to studies directed specifically at the group of students with whom this investigation is concerned.

The subjects for this study were the two hundred and fifty-seven evening college graduates (those students who completed fifty per cent or more of the total bachelor's degree program through the evening division of the University) who received the Bachelor of Arts degree, the Bachelor of Science in Business Administration, or the Bachelor of Science in Engineering degree from the University of Buffalo between February, 1952 and June, 1958. The graduates included in the study represent approximately seventy-five per cent of the total number of students receiving degrees in these three areas since the Evening Division was established in 1923.

Data were obtained from two sources: student records on file in the office of the Registrar and personal interviews. These interviews were conducted with a 15.6% random sample of the total population. Critical ratios were computed for several variables to compare the sample with the total population. Since differences were not significant at the five per cent confidence level, it appeared reasonable to assume that the sampling was unbiased.

Seven specific areas of information were defined to serve as a basis for the investigation. Consultant help and piloting were employed to construct the two data gathering instruments: a work sheet for use with student records and a structured schedule for the personal interviews. Data were thus obtained pertinent to the following areas:

- Personal characteristics including age at the start and end of the evening college program, sex, marital status, number of dependents, veteran status, and social class background.
- Pre-college preparation including type of high school program followed, standing in high school graduating class, and regents or school average.
- College career including transfer and/or day school credit, day school rejections, number of years to earn the degree, major fields of study, and final college averages.
- Employment factors including extent of employment, income, non-financial employer assistance, and promotion possibilities associated with earning the degree.
- Financial assistance including sources and relative importance.
- Possible motivating factors including reasons for starting evening college, ultimate goals, and highest educational level reached by relatives and friends.
- 7. Student opinions concerning various items related to evening college study including effect of marriage, reasons for attending evening college rather than day school, effect of advisement, effect of teachers, special problems encountered, and reasons for success in earning the degree.

The extensive findings in these seven areas do not lend themselves to brief summary in an abstract of this length.

As a result of the findings of this study, implications were drawn for further research related particularly to administrative practices in the evening college, motivational factors of adult students, and student-teacher relationships.

Microfilm \$2.50; Xerox \$7.80. 170 pages.

EDUCATION, HISTORY

THE ANALYSIS AND INTERPRETATION OF THE USE OF PRESIDENTIAL AUTHORITY TO ORDER UNITED STATES ARMED FORCES INTO MILITARY ACTION IN FOREIGN TERRITORIES WITHOUT A FORMAL DECLARATION OF WAR

(L. C. Card No. Mic 60-1084)

William Gabriel Carras, Ph.D. New York University, 1959

The purpose of this study was to analyze and interpret the use of presidential authority to order United States Armed Forces into military action when a state of formal hostilities did not exist. Selected instances in which presidents so acted between 1789 and 1956 were listed and described with regard to the immediate background and the stated reason for each action. Possible trends were sought in the stated bases of authority upon which the actions were undertaken.

Since World War II, national attention has centered upon this use of presidential authority in several crises. There has been disagreement as to what constitutes the proper use of this authority and its actual historical development. This study has dealt with the historical use, not its constitutionality, being concerned with those instances of the actual use of this authority.

A list of one hundred and sixty-one instances was compiled from the Report of the Committee on Foreign Affairs, Number 127, 82nd Congress, 2nd session and House Document, Number 443, 84th Congress, 2nd session. Ond hundred and forty-one instances fell within the stated scope of the problem, its delimitations and definitions.

For each selected instance was established a concise description of the circumstances, the duration, the type of military action, the treaty involvement with the United States and the geographic area in which it occurred. For each instance the stated reason and nature of American interest involved were reported as well as the stated basis of authority under which each action was taken. Research was made in public documents, including the messages and papers of the presidents, the Annual Reports of the Navy and War Departments found in House and Senate Executive Documents and American State Papers.

The data collected were classified according to the stated reasons, the treaty involvement which required or permitted the United States the use of its armed forces, the duration, service and type of action, and the geographic proximity to the United States, for each instance. The instances were further classified under the stated bases of authority, whether action was taken with prior congressional authority, on presidential authority alone, or followed by congressional authority after the action was taken by initial presidential action. Each instance was further classified as to frequency of the type of order and the frequency of use by the various presidents. The selected instances were organized into five time periods, 1789 to 1830, 1830 to 1898, 1898 to 1917, 1918 to 1941 and 1941 to 1956.

This study disclosed that most instances involved the protection of the rights, lives and property of American citizens and the rights and interest of the United States and that the employment of the armed forces was a constant characteristic of the national history. Twenty-six of the thirty-three presidents used the authority. An

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important relationship between the use of presidential authority without prior congressional authority and the means of communication and transportation was discerned. The trend in duration showed that the incidents before 1830 were of longer duration than those in the remainder of the nineteenth century. Toward the end of the century, this trend reversed itself and the trend toward longer duration continued after the second world war. Naval actions predominated throughout the whole industry. More recently, the emphasis has been on combined operations. Actions involving the use of army ground forces have been of a more serious nature than the others. Treaty involvement which permitted or required the use of armed forces began in the mid-nineteenth century and developed as a form of quasi-regulation, self imposed. A new and stronger trend developed after the second world war in which the use of forces was institutionalized through such instruments as the United Nations, the North Atlantic Treaty Organization and other mutual security systems.

With regard to the stated bases of authority on which the armed forces were committed to military action, the presidents acted in more than three-quarters of the selected instances without prior or subsequent congressional authority expressed by special act or resolution. The study has demonstrated that the use of presidential authority to order the armed forces into military action without prior congressional authority is historically established practice in United States foreign relations regardless of doubts or debates as to its precise constitutionality.

Microfilm \$5.50; Xerox \$19.35. 430 pages.

PUBLIC EDUCATIONAL CHANGES THROUGH LEGISLATION IN TENNESSEE, 1935-1959.

(L. C. Card No. Mic 59-6283)

Edell Midgett Hearn, Ed.D. The University of Tennessee, 1959

Major Professor: L. O. Haaby

This study involved an examination of significant developments in public education, grades one through twelve, in Tennessee as reflected in public school legislation between the years 1935-1959. The study presented legislative acts which endeavored to meet the changing needs of the people relative to education.

It was presented in narrative form, including data shown in tabular and graphic representations. The major sources of data included: (1) Constitutions of Tennessee; (2) Public Acts of Tennessee; (3) State Surveys of Education; (4) Minutes of the State Board of Education; and (5) selected publications of the State Board of Education, the State Department of Education, and the Tennessee Education Association.

The major generalizations drawn from the evidences presented in the study include:

1. Educational legislation in Tennessee has at one time or another included most phases of public education. Legislation was particularly specific and comprehensive prior to 1945. Since 1945 the legislature has delegated more and more of its policy-making authority to the State Board of Education, the State Department of Education,

the Commissioner of Education, and the local boards of education.

- 2. The legislatures have from time to time enacted laws that were redundant and unnecessary as a result of not being sufficiently aware of existing educational laws and regulations.
- 3. While much educational legislation in Tennessee has been general, the specific interpretation, application, and enforcement of the legislation has been delegated to other groups or agencies.
- 4. The Governor of Tennessee has had more authority over the passage of school legislation than any other person or group in the State.
- 5. School services including health, welfare, and special education for pupils in Tennessee have been steadily extended as the result of the efforts of the State Board of Education in promoting these services.
- 6. The idea of separate but equal schools for the Negro and white children has received legislative attention throughout the State's history. Currently, the State laws are so designed that this problem is left to the local boards of education.
- 7. The period 1938-1945 was one hardship relative to the advancement of education in Tennessee because of a lack of funds, a shortage of teachers, and the general illeffects of World War II.
- 8. During the period 1935-1959 the State's program of education was more effectively coordinated and directed. The elementary and secondary schools were unified.
- 9. The program of instruction and in-service education have both improved steadily during the past two decades. The State has been active in providing the leadership necessary for these programs, which have involved thousands of teachers and lay people whose purpose was to improve the program of education. The State Board of Education, through its rules and regulations, continues to provide the framework for the operation of the schools.
- 10. The State's program of education has witnessed greater educational accomplishments since the establishment of the Minimum Foundation Program in 1947 than during any other comparable period.
- 11. Educational laws have been numerous throughout the State's history. Much of the success of the State's program of education in the future will depend upon how well the laws are interpreted and administered by the different school agencies and citizen groups.

Microfilm \$5.05; Xerox \$17.80. 394 pages.

EDUCATION, PHYSICAL

A STUDY OF THE POLICIES GOVERNING INTERSCHOLASTIC ATHLETIC PROGRAMS FOR GIRLS IN AMERICAN PUBLIC SECONDARY SCHOOLS

(L. C. Card No. Mic 59-6213)

Lacey Dell Bell, Ed.D. New York University, 1959

The Problem and its Significance

An examination of the interrelatedness of purposes of secondary education and interscholastic athletics, and of statements of interscholastic athletic policy viewed against an accepted criterion establishes principles to guide formulation of policy in accord with the purposes of modern secondary education.

The significance of the problem arises from controversies related to girls' interscholastic athletic programs in secondary schools.

Related Literature

No studies of interscholastic athletics were found which viewed present policies against behavioral goals of general education in high school, or which related to broad educational principles from which policies emerged.

Procedures Used in Collecting and Treating Data

Data concerning interrelatedness of purposes of secondary education and of interscholastic athletics were collected from the literature in the behavioral sciences, education, biology, growth and development.

Data concerning present policies were collected from regional, state, and national organizations who assumed some responsibility for formulating, recommending, or, implementing policies for secondary education or athletics. These data were analyzed and classified. This process resulted in composite statements representing present policy. Validity was based on formulation, acceptance, use, and recommendation by school administrators; competent educational organizations; enforcement and use by schools and by state athletic associations.

The evaluative criterion was adapted from behavioral goals of general education in high school. Validity was found in its source and in its applicability to the study.

Policies were evaluated through the application of the evaluative criterion, an analysis of this application, and a philosophical interpretation of the analysis. Interpretation of the evaluation was supported by documentary analysis.

The established principles were based on data gathered in the study. Additional data from literature in the behavioral sciences, education, biology, growth and development were used to support principles.

Results

- 1. Three principles and nine-sub-principles were
- 2. Present policies revealed consistency on the national level and inconsistency on the state level.

- The most thorough and complete standards collected in the study were those of the Division for Girls and Women's Sports (DGWS). These standards are not fully utilized by state athletic associations.
- 4. Present policies, in many states, limit program variety, thus failing to meet all students' needs and interests.
- 5. There seems to be a trend toward more favorable attitudes and a wider concern about interscholastic athletics for girls.
- 6. Few schools use this medium of education effectively.

Conclusions and Recommendations

- 1. Interscholastic athletics, with educational goals, assist the participant to manifest mature intellectual, cultural, and healthful behaviors in relation to self-realization, desirable interpersonal relations in small groups, and effective membership and leadership in large organizations.
- Effective program administration and planning must be supplemented by a belief in, and respect for, interscholastic athletics in achieving educational ends.
- 3. A need for communication exists between DGWS and program administrators.
- 4. Controversies are traceable to leadership and "biorigin" of policy. The DGWS, a nationally recognized primary source of policy, exerts indirect control of athletic programs by recommendation but can neither legislate nor enforce policy. State athletic associations, locally recognized primary sources of policy, exert direct control by legislation and enforcement.
- Participation and leadership should be sought and nourished.
- 6. DGWS program administrator participation may be a vital factor in eliminating differences and establishing responsibilities. "Belonging and contributing" are essential patterns of democratic group endeavor. Generally, deep feelings of responsibility parallel "sharing in planning."
- 7. It is recommended that studies be made concerning (1) coordination of controlling organizations for standardizing and implementing best policies;
 (2) local programs in relation to expected educational outcomes, community patterns, and consistency between policies and practices; and (3) the effects of participation on (a) physical education teacher competence, preparation, and recruitment; and (b) success in family and civic life.

Microfilm \$9.60; Xerox \$34.00. 757 pages.

A SURVEY OF THE STATUS OF THE HEALTH AND PHYSICAL EDUCATION PROGRAM FOR ELEMENTARY GRADES IN THE BUFFALO PUBLIC SCHOOLS

(L. C. Card No. Mic 60-1540)

William John McColgan, Ed.D. The University of Buffalo, 1960

Statement of the Problem

It is the purpose of this study to evaluate the program of health and physical education of the elementary grades in the public schools of Buffalo, N.Y., by use of the La Porte Health and Physical Education Score Card No. 1., and to analyze the data in the light of certain factors which may influence the health and physical education program.

Need for the Study

The Buffalo Public School System is in a state of transition from a K-8; 9-12 organization to an elementary grade, junior high school, and senior high school organization.

As this transition progresses, a knowledge of the status of the program and the analysis and interpretation of collected data will be useful as a guide in determining what changes and adaptations should be made.

Data collected in this survey will be helpful in planning the long range building and rehabilitation program.

Administrators, supervisors, and teachers should have an opportnuity of being more cognizant of the characteristics of a good program and thus be better able to judge significant strengths and weaknesses in the program.

Since no similar study of the physical education program in Buffalo has been made at these grade levels the data collected will fill an essential need.

Procedure

The La Porte Health and Physical Education Score Card No. 1 was selected as the survey instrument. The 76 public schools in the city of Buffalo which housed grades 1-6 and enrolled 46,391 children were included in the survey.

The 76 schools were grouped according to type of school, type of neighborhood, and school size. The techniques of interview and observation were utilized to collect the data during the school year 1957-1958. Means, medians, ranges, and percentages of effectiveness were calculated and used to analyze and compare total program scores, scores of the major areas of the score card, and item scores.

Presentation of the Findings

The range of the total scores was from 75-113 points. The possible total score was 150 points. The mean scores was 99.83 and the median score was 102.25. This means that Buffalo is 66.60% effective in meeting the standards of the La Porte Score Card No. 1. The Buffalo scores compare very favorably with the scores of other studies investigated by the writer.

A study of the relationships between the scores of elementary grades and the factors used for comparison indicate that schools enrolling between 600 and 799.99 pupils, located in more favored neighborhoods, and housing grades

from 1-8 tend to score highest on the La Porte Score Card No. 1.

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A study of the area scores indicates that Buffalo scores highest in Medical Examinations and Health Service, 86.11% effective. Program of Activities is next followed by Indoor Facilities, Organization and Administration of Class Programs, and Outdoor Facilities with scores of 77.26%, 63.21%, 59.97%, and 37.04% effective respectively.

A study of the item scores indicates that the Buffalo schools scored the maximum on 13 items and 0 on 6 items. Nine of the remaining items were scored in the good category, 7 in the fair category, and 2 in the poor category.

Four of the items scoring 0 concerned corrective physical education, 1 concerned rest rooms for boys and girls, and 1 concerned a continuing course of study committee

Conclusions and Recommendations

The specific conclusions and recommendations presented stem from the findings that physical education programs in the Buffalo elementary grades do not vary appreciably from school to school and that the area of Outdoor Facilities is a weak spot in the Buffalo program.

Microfilm \$2.50; Xerox \$7.80. 168 pages.

AN EVALUATION OF CERTAIN AREAS OF PHYSICAL EDUCATION SERVICE PROGRAMS OF SELECTED WHITE AND NEGRO COLLEGES IN TENNESSEE

(L. C. Card No. Mic 59-6287)

John Ralph Puckett, Ed.D. The University of Tennessee, 1959

Major Professor: Galen N. Drewry

The problem in this study was to evaluate and compare the physical education service programs of five selected white colleges and five selected Negro colleges in Tennessee. Emphasis was placed on the areas of facilities and equipment, staff personnel, organization of the programs and curricula. The study encompassed the following sub-problems: (1) developing evaluative criteria, (2) submitting the evaluative criteria for validation by a panel of physical education specialists, (3) evaluating the physical education service programs of the selected institutions and (4) comparing the evaluations of the white institutions with those of the Negro institutions.

The evaluative criteria were formulated by modification and combination of the following evaluative criteria:
(1) The La Porte Health and Physical Education Score Card Number II, (2) Evaluative Criteria (1950 Edition) of the Cooperative Study of Secondary School Standards and (3) evaluative criteria for colleges of the Southern Association of Colleges and Secondary Schools. A supplementary checksheet was also used to obtain additional information related to the study.

Data for the study were collected primarily through personal interviews with the heads of the physical education departments and in some instances with other staff members of the selected institutions. Physical education facilities and equipment were observed to determine their availability and condition.

An analysis of the data revealed that there were wide variations in the evaluations of the selected institutions. The strongest area of the physical education service programs was that of organization of the programs and curricula. Other relatively strong areas were those of outdoor facilities, gymnasium areas, equipment offices, staff facilities, medical examinations, health services and locker and shower areas. Ratings were somewhat lower in the areas of supplies, equipment and staff personnel and were considerably lower in the areas of adaptive physical education and swimming pools, with the weakest area being that of swimming pools.

There was little difference in the over-all evaluations of the physical education service programs of white institutions and those of the Negro institutions. White institutions possessed slightly better physical education facilities and equipment, while Negro institutions were rated slightly higher in the areas of staff personnel, organization of the programs and curricula.

Differences were much more evident between physical education service programs of large and small institutions than between those of white and Negro institutions. Generally speaking, the larger institutions possessed better physical education facilities and equipment, better trained staff members and a greater variety of physical education activities than did the small institutions. In general, the small institutions were rated higher than were the larger institutions in the areas of outdoor facilities, medical examinations and health services.

Microfilm \$2.50; Xerox \$7.80. 169 pages.

A STUDY OF THE CONTRIBUTIONS OF PHYSICAL EDUCATION ACTIVITIES TO DEMOCRATIC EDUCATION FOR SECONDARY SCHOOL GIRLS

(L. C. Card No. Mic 60-1123)

Helen Agnes Spencer, Ed.D. New York University, 1959

The purpose of this study was to investigate the activities taught to the secondary girls to determine the opportunities in those activities which help prepare the individual for democratic living. Twenty activities and seven forms of participation (sports days, play days, intramural and varsity) were studied in depth to determine their contributions to democratic living. The selected activities were chosen from a classification which included all the desirable activities taught to secondary school girls. Included in this classification which included all the desirable activities taught to secondary school girls. Included in this classification were team sports, individual and dual sports, rhythmic and dance activities, formal activities and gymnastics, recreational and family activities, games of low organization, water activities and fundamentals.

The structure and skills of all the desirable activities were represented and the chosen activities were those in which participation was frequent.

The activities were rated against criteria which represented the values of democratic education. Twenty-one values were established and validated from an investigation of the literature on democratic education. Thirteen

of these values were related to the student in that they represented opportunities available to all youth in democratic education. Eight of the values represented the elements of democratic education that help the student meet his moral and social responsibilities.

Activities have varying potential for making contributions to educational values in a democracy. This is due to the facts that requirements for participation in the activities vary. The content or nature of each activity, when applied to the criteria, yielded quantitative measures of values; factors of frequency, intensity and duration acted as guides in determining qualitative measures of values. The evaluation of the activities determined the degree of potential inherent in each selected activity for providing opportunity for secondary school girls to develop the educational values previously established.

The method used to evaluate selected activities against established criteria followed the pattern used by Thurstone and Clave in the measurement of attitudes. The ratings were performed on the principle of "more or less" opportunity inherent in each activity to achieve each criterion. Information concerning the elements of the selected activities was placed on rating cards. These cards were arranged in piles of gradually decreasing value until all cards in each pile were of equal value in meeting an individual criterion. A five point scale was used to represent this potential. Five represented the highest potential and one the lowest. The ratings of the activities were recorded on master sheets by numbers. Investigation in this manner continued until no further distinctions were possible. The correlation coefficients of the last two ratings were above .91. These were computed by using the Pearson Product-Moment Correlations.

The results of this study indicate that physical education makes its greatest contributions to democratic education on the secondary level through what has been termed the extra-curricular activities. Of the twenty activities rated, team sports rated highest. A serious effort must be made to retain the extra-curricular activities. These have been termed the unnecessary "frills" of modern education. This study also refutes as unsound, the present trend of replacing the team sports in the physical education program of secondary school girls with individual and dual sports. Microfilm \$2.55; Xerox \$8.80. 195 pages.

EDUCATION, PSYCHOLOGY

THE EFFECTS OF AUDITORY DISTRACTION ON THE LEARNING, RETENTION, AND PERFORMANCE OF VERBAL TASKS.

(L. C. Card No. Mic 60-1320)

Joe Thomas Clark, Ed.D. University of Arkansas, 1960

Major Professor: R. M. Roelfs

Introduction

The purposes of this investigation were:

1. To determine if school noises affect the performance of students on meaningful and non-meaningful verbal tasks.

2. To determine if distractions in schools have a similar effect on the performance of students with high, average, or low mental ability.

3. To determine if material learned or read under distraction is retained as well as material learned or read under quiet conditions.

Pupils performed under three auditory conditions: Condition 1. A record of "white" noise was played at a volume of sixty-two decibels which was sufficient to mask noises external to the experimental room.

Condition 2. A record of a classroom in operation was played with the volume varying from sixty to sixty-eight decibels.

Condition 3. A record was played that consisted of a physical education calss, industrial arts class, students in the hall, and a band practicing. The volume varied from sixty to seventy decibels.

The study was divided into two separate experiments. Subjects for each experiment were selected by a stratified random sampling technique and divided into three equal groups on the basis of scores from the Otis Quick-Scoring Test. The scores of the low, medium, and high mental ability groups were 93 or below, 99 to 106 inclusive and 114 and above respectively.

Experiment I

The sample was composed of sixty high school juniors or seniors divided into three groups of twenty each.

The verbal tasks consisted of three lists of nonsense syllables chosen from a list prepared by Hull. Each list consisted of eight syllables of three letters each. The lists were presented on a memory drum at two-second intervals. The order of presentation of the three lists and of the three distraction conditions was selected at random with the restriction that each subject learned each list and performed under each condition. The lists were learned to a criterion of three correct anticipations.

The learning scores consisted of the number of trials to learning and the number of incorrect anticipations. There were also two retention scores available, number of syllables recalled and number of syllables recognized. The retention scores were obtained one week after the lists had been learned.

Experiment II

The sample was composed of sixty-nine eighth grade students divided into three equal groups.

The verbal tasks consisted of the three forms of the paragraph test of the Nelson Silent Reading Test. The order of presentation of the three forms of the test and the three distraction conditions was selected at random with the restriction that each subject took each test and performed under each condition. A retention test was taken one week after the original scores were obtained.

Statistical Procedures

Analysis of variance was used to determine if the performance and retention scores for the three different groups under the three conditions were significantly different. This statistical procedure is the most appropriate one for the three-by-three factorial design used in this study. All values were considered significant at the 5 per cent level of confidence.

Conclusions

- 1. School auditory distractions have little effect on the learning of nonmeaningful verbal tasks or on reading comprehension. However, reading for general meaning is adversely affected by school distractions.
- 2. School auditory distractions have a similar effect on the performance of students of varying levels of mental ability.
- 3. Verbal tasks performed under school distraction are retained as well as those learned or read under quiet. However, the retention of material read for general meaning is adversely affected by distraction.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

TEACHING MACHINES: AN INVESTIGATION OF CONSTRUCTED VERSUS MULTIPLE-CHOICE METHODS OF RESPONSE.

(L. C. Card No. Mic 60-1:09)

Edward Bernard Fry, Ph.D. University of Southern California, 1960

Chairman: Professor Meyers

Teaching machines are defined as automatic or partially automatic devices which present a question or other stimulus to a student, provide a means of response, and then inform him of the correctness of his response immediately after he has responded.

An exhaustive survey of the related literature revealed that Pressey issued the first published report of a teaching machine in 1926. His was a simple mechanical device making use of multiple-choice questions. Later he and his students developed studies using punchboards that gave immediate knowledge of results to multiple-choice questions. Pressey believed the use of teaching machines to be in harmony with such learning theory as that proposed by Thorndike.

In 1954 Skinner proposed that teaching machines were effective and in harmony with such major learning principles as "successive approximations" and an adequate schedule of reinforcement (frequent rewards after small units of work). Skinner and his followers expressed strong preference for devices which required that the

student respond by constructing his own answer, for example, by writing the answer from memory rather than by recognizing and selecting one of several proffered choices.

The purpose of this study was to determine, if possible, which of the two modes of response was the more efficient for teaching a list of Spanish words and phrases to 153 ninth grade beginning Spanish students. A pilot study showed that when students were required to construct responses, better scores resulted on a posttest but that a longer training time was taken.

The major portion of the study was conducted under several controlled conditions in which the variables of time and number of repetitions could be studied. Under Condition I, both experimental groups (multiple-choice versus constructed response) worked to a mastery criterion of two correct responses while working time was recorded. Under Condition II, both groups were stopped before subject mastery was reached, thus allowing them equal total working time. Under Condition III, the stimulus items (English words) were presented to both groups by means of a large flashcard, thus allowing equal stimulus presentation time and equal responding time for each item besides controlling the number of responses made by each student. Learning was measured during two posttests, both consisting of equal numbers of multiple-choice and constructed items. One posttest was given immediately after training, the other after a two-day interval.

Results. Responses to the multiple-choice items all approximated the maximum possible score and hence did not reflect any significant differences. Constructed responses, on the other hand, showed significant results favoring the constructed mode of training response under all three conditions for both posttests. Under Condition I, where time was allowed to vary, constructed responses took significantly longer.

Conclusions. Given the conditions prevailing in this study, constructed training responses result in more learning than do multiple-choice responses if the criterion of learning is recall. The literature has indicated that the use of teaching machines offers great promise in the teaching of many phases of nearly every school subject. Teaching machines enable one to make interesting application of learning theory and the results of learning experiments, and would appear to merit considerable attention from educators. They are excellent research tools for curriculum construction and psychological experimentation.

Where it is required that the student be able to recall the learned material unaided, and given the conditions of this experiment, constructed training responses should be used, even if training time must be limited.

Microfilm \$2.75; Xerox \$9.70. 211 pages.

THE VALUE OF CAREER PUBLICATIONS PREPARED FOR COLLEGE GRADUATES BY MANUFACTURING COMPANIES

(Publication No. 22,647)

Bruce Grant, Ed.D. University of Colorado, 1957

Supervisor: Associate Professor: Clarence W. Failor

The purpose of this study is to investigate career publications prepared for college graduates by manufacturing companies in order to determine the value of these publications as a source of information to college graduates in their choice of a career. This includes determining the diversification of topics of information presented, the topics of occupational information covered, the quality of information given, and the quality of the organization of the career publication.

Data were secured from the files of the University of Colorado Placement Bureau. A representative sample of 170 career publications prepared for college graduates by manufacturing companies was drawn. Three sets of criteria were applied to the career publications: (1) criteria of topics of occupational information, (2) criteria of quality of information, and (3) criteria of quality of the organization of the career publication. The quality of the information and the quality of the organization of the career publication are established in the meeting of the criteria, without specifying the degree of the quality. Limitations to criteria that are met are shown. Comparisons of the findings obtained by the investigator in applying the criteria of quality of information and criteria of quality of the organization of the career publication with those obtained by thirty graduate students were made, with no significant difference found at the 5 per cent level

The educational contribution of this study is its presentation to the college graduate of knowledge that can serve him in the making of a wise decision regarding his choice of a career, thus increasing the probability that he will attain success and satisfaction in his vocational life.

Fifty-two topics of information were found in the career publications, but only sixteen or 31 per cent of these topics are in 50 per cent or more of the publications, and only thirty or 18 per cent of the companies include 50 per cent or more of the topics in their publication. Of the 27 topics of occupational information only eight or 30 per cent are in 50 per cent or more of the publications, and only fourteen or 8 per cent of the companies cover 50 per cent or more of these topics in their publication. Two or 25 per cent of the eight criteria of quality of the information are met by 50 per cent or more of the publications, and 54 or 32 per cent of the companies meet 50 per cent or more of these criteria. Two or 20 per cent of the ten criteria of quality of the organization of the career publication are met by 50 per cent or more of the publications, and 32 or 19 per cent of the companies meet 50 per cent or more of these criteria.

Diversification of topics of information is limited, and a majority of the topics of occupational information are not found in most of the career publications. The quality of the information and the quality of the organization of the career publication are limited by too many criteria not being met or too many of those which are met being

subject to limitations. These weaknesses restrict the value of career publications to college graduates. The strength of the career publication lies in its exceptionally attractive format, which invites reading.

It is recommended to college graduates that they circumvent the limitations of career publications by the use of other sources of information and by suggestions offered as a frame of reference in their utilization of sources of information in their choice of a career.

Microfilm \$2.50; Xerox \$8.40. 183 pages. Mic No. 60-1732

RELATIONSHIP BETWEEN MANIFEST NEEDS AND DIFFERENTIAL ACHIEVEMENT OF HIGH SCHOOL STUDENTS

(L. C. Card No. Mic 60-1525)

Montane C. Gustafson, Ed.D. The University of Nebraska Teachers College, 1960

Adviser: Dr. Warren R. Baller

Statement of the Problem

The purpose of the study was to determine the relationship between manifest need variables, subject matter interests, and measured academic achievement. A further purpose of the study was to determine if manifest needs show particular relationships to specific achievement criterion measures.

Theoretically, manifest needs are related to achievement. Individuals who possess a specific need tend to seek activities which will satisfy the need. Manifest needs refer to a learned tendency of the individual to seek certain experiences for their effects. In classroom learning situations the student's behavior may be affected by his manifest needs and their relative strengths.

Intelligence and interest in subject matter are other variables which have a bearing upon student achievement. Students with greater intelligence tend to learn more effectively on a given subject matter. Interests in a particular subject, according to theory, influence the attention and time a student will give to learning that subject. The present study was designed to determine in addition to the relationship between need variables and achievement criteria that part of the criteria which could be attributed to subject matter interests and intelligence.

Plan and Procedure

The Edwards Personal Preference Schedule was used to assess 15 need variables. The Cooperative Achievement Tests, GAT I, Social Studies and GAT II, Natural Sciences provided measures of achievement criteria. Subject matter interest scores in science and social studies were determined by an interest index device which was constructed for the study. Intelligence was measured by the Otis Quick-Scoring Mental Ability Test, Em.

The study sample was composed of 206 high school

senior boys who had completed all but the last few weeks of a four-year high school course of study. The investigator

administered all instruments in the study.

The multiple regression technique was used to analyze the relationship of need variables, interests, and intelligence to achievement criteria. First, a multiple regression which utilized social studies interest scores, science interest scores, and intelligence scores as prediction variables was computed for each criterion. Secondly, multiple regressions were computed for criteria measures which used one need variable and intelligence scores as prediction variables. Prediction variables were successively eliminated from the foregoing regressions and the loss in predictive value which occurred due to this elimination was tested by an F-test. The final multiple regressions were developed from those interest and need variables which could not be statistically eliminated from all previous regressions.

Finding of the Study

The EPPS need variable, intraception, was found to make a significant contribution to the prediction of both criteria. Also the EPPS need variable, succorance, made a significant contribution to the prediction of the natural science achievement criterion. All of the contributions to the prediction of achievement criteria which were made by the above need variables were in addition to that part of achievement which can be attributed to interest and intelligence variables.

Science interest scores were related to both criteria. These scores could not be statistically eliminated from prediction batteries which contained need variables and intelligence scores. Social studies interest scores made a significant contribution to the prediction of the social studies achievement criterion only. Social studies interest scores acted as a suppressor variable in that they made a significant contribution to the predictive value of the test battery, but the zero-order relationship with the criterion was non-significant.

None of the 15 EPPS need variables other than intraception and succorance made statistically significant contributions to the prediction of the achievement criteria.

Intelligence scores were significantly related to both criteria. They could not be eliminated from the final multiple regressions without the occurrence of a significant loss in predictive value.

Microfilm \$2.50; Xerox \$5.20. 103 pages.

THE USE OF SELECTED STANDARDIZED TESTS AS PREDICTORS OF ACADEMIC SUCCESS AT OKLAHOMA COLLEGE FOR WOMEN

(L. C. Card No. Mic 60-1244)

Fontella Thompson Kimbell, Ed.D. The University of Oklahoma, 1960

Major Professor: Gail Shannon

The purpose of this study was to investigate interrelationships which exist between academic success and the general abilities, special abilities, interest patterns, and personality traits of the students at Oklahoma College for Women. The problem was to formulate regression equations for use in predicting academic success for each class level.

Two hundred thirty-one students enrolled during the second semester, 1958-59, were tested with the following standardized instruments: School and College Ability Test, Form 1 A; Sequential Tests of Educational Progress in Mathematics, Form 1 A; and Reading, Form 1 A; Cooperative English Test, Form PM, Part 1; Kuder Preference Record, Vocational Form C; and Guilford-Zimmerman Temperament Survey.

The hypotheses tested were:

1. There are no significant differences between the mean raw scores in general abilities and special abilities of the classes at Oklahoma College for Women.

2. There are no apparent differences between interest patterns of students on the basis of class stratification.

3. There are no apparent differences between personality characteristics of students on the basis of class stratification.

Findings:

1. Significant differences were found between freshmen and juniors on English Usage and SCAT Quantitative mean raw scores; between freshmen and seniors on SCAT Total, SCAT Verbal, STEP Mathematics, and STEP Reading; between sophomores and juniors on English Usage and STEP Mathematics; between sophomores and seniors on STEP Mathematics; and between juniors and seniors on all tests except STEP Reading.

2. The hypothesis that there were no apparent differences between interest patterns of students on the basis

of class stratification was accepted.

3. The hypothesis that there were no apparent differences between personality characteristics of students on the basis of class stratification was accepted.

The regression equations obtained for prediction were:

Freshman

$$X'_1 = .6657 + (.0070) (X_2) + (.0070) (X_3) + (.0067) (X_4) + (.0194) (X_5) + (.0215) (X_6) + (.0129) (X_7)$$

Sophomore

$$X'_1 = .8177 + (.9161) (X_2) + (.0021) (X_4) + (.0166) (X_5) + (.0029) (X_6) + (.0097) (X_7)$$

Junior

$$X'_1 = .7475 + (.0123) (X_2) + (.0025) (X_3) + (.0212) (X_4) + (.0214) (X_5) + (.0050) (X_6) + (.0010) (X_7)$$

Senior

$$X'_1 = -2.5334 + (.0107) (X_2) + (.0272) (X_3) + (.0454) (X_4) + (.0373) (X_5) + (.0091) (X_6) + (.0054) (X_7)$$

With multiple correlations of .52, .70, .61, and .50 for freshmen, sophomores, juniors, and seniors, respectively, it was concluded that the battery of tests were of little practical value in predicting academic success at Oklahoma College for Women.

It is recommended that this study be extended by computing partial correlations in order to determine those tests which do not contribute to the prediction of academic success. Microfilm \$2.50; Xerox \$4.20. 78 pages.

A STUDY OF OVERT AND FANTASY EXPRESSIONS OF VARIABLES RELATED TO YOUNG CHILDREN'S MOTIVATION TOWARD WORKING INDUSTRIOUSLY IN SCHOOL

(L. C. Card No. Mic 60-1369)

Clara Phillips Melville, Ph.D. Stanford University, 1960

This study was designed to investigate the overt and fantasy expressions of some of the variables thought to be related to young children's motivation toward working industriously in school. It is a part of a larger study being conducted by Dr. Pauline S. Sears and her associations at the Laboratory of Human Development at Stanford University

Two groups of subjects, a High industry group (25 children who spent more time working industriously in school than two-thirds of their classmates) and a Low industry group (23 children who spent less time working in school than two-thirds of their classmates), were selected on the basis of a point sample observation of their school behavior in first and second grade. Because these groups were unbalanced as to sex, a second group (Group C), composed of 41 experimental children and 6 non-experimental children and divided into a Low and High industry group at the mean industry score for their own sex in their respective classrooms, was formed for the purposes of testing differences within sexes. Teacher ratings, achievement and intelligence test scores, and fantasy expression of achievement and work routine and aggressive behaviors in a doll play classroom setting were obtained.

Hypotheses were tested as to (1) the relationship between overt and fantasy expressions of achievement and industry; (2) the relationship of these overt and fantasy expressions to the self-esteem measure; and (3) of certain variables thought to be theoretically related to achievement and industry in school.

The major findings were these:

(1) With respect to the first group of hypotheses regarding the relationship between overt and fantasy expressions of achievement and industry, it was found that the Low and High industry groups differ significantly on the fantasy measure in units of work routine category, which depicts dolls as clearly involved in fantasy actions indicating working at a school activity. These differences are found between both High and Low industry boys and girls in Group C. These differences are all significant at less than the 5% level. There is no difference between the experimental groups in units of the achievement category, but within sexes in Group C, High industry girls use this category significantly more than Low industry girls, though there is no difference in the use of the category by the two groups of boys. Low industry children give significantly more total aggression in fantasy than do the High industry group, and these differences are significant at less than the 10% level for both boys and girls. The difference for boys is highly significant at between the 2 and 5% level.

When categories on the fantasy measure were combined into appropriate, school-related thematic and inappropriate thematic acts, the High industry children give more appropriate thematic responses, while Low industry children give more inappropriate kinds of fantasy. These differences are significant for both boys and girls at less than the 7% level.

There is a positive relationship between teacher ratings of the achievement motive as defined in this study, and the number of achievement responses given in fantasy, but this relationship does not reach significance. When intelligence is held constant, there is a positive relationship between achievement test scores in reading and number of achievement responses given in fantasy only for second grade girls. This relationship is highly nega-

tive for second grade boys.

(2) Industry and self-esteem. High industry children in this sample tend to rate themselves realistically (as their peers rate them) on four areas of school activities on a self-esteem measure, while Low industry children rate themselves differently (unrealistically) than their peers rate them, though this tendency does not reach significance. When direction of discrepancy between peer and selfrating is examined on the basis of overt industry, Low industry children are found to rate themselves better than their peers rate them, while High industry children rate themselves lower than their peers rate them.

(3) Identification, sex differences. High industry children use the teacher doll as agent of thematic actions more frequently than do Low industry children, but when these findings are broken down by sex, it is the girls who use this doll significantly more than do the boys. Within sexes in Group C, there is no difference between either Low or High industry boys or girls in their use of the teacher doll. Within this sample, apparently the use of the teacher doll

is more related to sex than to industry.

Sex differences in relation to industry in school were found in nearly every section of this study. Girls are more industrious in the overt behavior observed in their classrooms, give more work routine and appropriate thematic responses on the fantasy measure, have higher achievement test scores in reading, and rate themselves less well than their peers rate them on the self-esteem measure. Their self-ratings on this measure are also somewhat lower than boys' self-ratings. Boys on the other hand, give more aggressive and inappropriate responses in fantasy, are less industrious in their classrooms, receive lower achievement test scores in reading, yet on the selfesteem ratings rate their school behavior better than their peers rate them.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

THE FIRST YEAR OPERATION OF TITLE V-A OF THE NATIONAL DEFENSE EDUCATION ACT OF 1958 IN THE STATE OF CALIFORNIA

(L. C. Card No. Mic 60-1349)

Patricia Louisa Popp, Ed.D. Stanford University, 1960

The purpose of this study was to make an analysis of the first year operation of Title V-A of the National Defense Education Act in the State of California.

Primary data for the study consisted of all materials relevant to the 223 applications for Title V-A funds received by the Bureau of Guidance of the State Department of Education by June 5, 1959. Additional data were obtained in interviews with permanent staff members of the Bureau of Guidance, special consultants, and a member of the State Advisory Committee.

Six points of reference were used to organize the analysis of the data including (1) the applications; (2) processing the applications; (3) relationship of need and proposed action; (4) details of proposed action; (5) distribution of

funds; (6) evaluation and supervision.

Major findings were as follows: (1) Of the 223 applications received thirty-eight were classified for 1959-60, sixteen were withdrawn, and 169 received funds for a 1958-59 project. These applications represented 134 single district applicants and twenty-seven joint and single county office applicants. (2) Major problems related to processing applications included interpretation of three minimum standards pertaining to applicants' eligibility for funds and establishing policies for approval of activities and purchase of materials and equipment. Ninety percent of the projects were revised. (3) Eight guidance services were selected as basic descriptive categories for analyzing the relationship between needs and proposed actions. These services included testing; counseling; appraisal of individual differences (non-testing); group guidance; evaluation and follow-up; guidance and curriculum; educational and occupational information; job and educational placement. Categories of needs and proposed action were identified within these services including hire professional and clerical staff; add time; research; in-service training; purchase materials and equipment; and expand programs. There were considerable differences between perceived needs and proposed action. Needs expressed in 25% or more of the projects included expansion of testing and counseling programs to identify and counsel academically talented students; evaluation of guidance programs; purchase testing and occupational and educational materials; secure professional and clerical services for counseling. (4) Major emphases in proposed action were expansion of testing, counseling, and evaluation programs; purchase of test and occupational and educational materials; secure professional and clerical services for counseling. (5) Slightly over \$351,000 was encumbered for first year projects. A priority of financial support listed in descending order was: testing; counseling; occupational and educational information; evaluation; appraisal of individual differences; group guidance; guidance and curriculum; job and educational placement. Materials, professional services, clerical services, equipment, and travel expenses received financial support in this priority order. (6) Evaluation and supervision will be concerned with determining the impact of Title V-A on guidance services in California and with project accomplishment. Both subjective and quantitative measures will be used.

The major conclusions reached were that the first year operation of Title V-A in California increased counseling services for able students and expanded testing programs for identification of these students. Purchase of test and occupational and educational materials received primary financial support. Evaluation of projects and the impact of Title V-A on guidance services is a problem area in need of study. Interest in the Title V-A operation was widespread throughout the State.

Microfilm \$3.25; Xerox \$11.50. 252 pages.

EDUCATION, TEACHER TRAINING

DESCRIPTIVE GRAMMAR IN THE TEACHING OF ENGLISH: A SURVEY OF ITS EXTENT, USE, AND STATUS IN THE PUBLIC HIGH SCHOOLS OF CALIFORNIA.

(L. C. Card No. Mic 60-1344)

Charles Allen Alva, Ed.D. Stanford University, 1960

Growing dissatisfaction among the English-teaching profession with traditional grammar has been augmented in recent years by developments in linguistic science and in descriptive grammar. But the possible introduction of a method of analyzing language that could replace or modify traditional grammar has also caused great debate. This study, which examines the nature of the resultant controversy, seeks to clarify basic issues that affect the teaching of English grammar. A second purpose is to survey teachers of English for evidence as to their adoption and use of descriptive grammar in order to discover what implications exist for teaching of grammar, teacher-preparation in English, and curriculum.

Professional literature was reviewed that discusses the pedagogical implications of teaching descriptive grammar, that reports on classroom use of this method, and that cites experimental research in applied linguistics. Two general conclusions may be advanced: (1) The basic principles of linguists about the nature of language processes are generally accepted among the profession. (2) Criticisms of descriptive grammar are that it is difficult for teacher and student to learn, that its terminology lacks uniformity, and that systems of descriptive analysis differ. Those criticisms are not, in general, sustained by either the limited research available or by the reports of teachers using descriptive grammar.

The names of English teachers using descriptive grammar were obtained by writing their department heads. Ninety-one per cent of the chairmen of English departments of all senior high schools in California responded to this request, supplying the writer with 318 suggested names. Major findings and conclusions listed below are based on the responses to the questionnaires returned by seventy-seven per cent of those teachers and screened by

the application of four criteria.

(1) Descriptive grammar is being taught by 120 teachers of English, that is, by almost four per cent of all highschool English teachers in California. Substantial evidence indicates, however, that interest in this subject is growing: increasing course offerings in linguistic science and descriptive grammar by teacher-training institutions; publications of the National Council of Teachers of English that urge adoption by teachers of many principles of linguistic science; increasing number of textbooks about descriptive grammar; wide dissemination of linguistic information by regional and state conferences, through institutes, and in professional publications.

(2) Variables examined were years of teaching experience, whether majors or minors in English, sex, school size, and school location. No single variable separated teachers who use descriptive grammar from those who do not. The conclusion is therefore advanced that descriptive grammar can be utilized by a wide range of teachers

in the state.

(3) The teaching practices of respondents do not differ from the practices of teachers who use traditional grammar in terms of grade levels or length of training in grade. That a majority of the respondents use descriptive grammar in addition to, not as a replacement for traditional grammar would seem to indicate that its full potential is not being realized. Research is needed to explore this hypothesis.

(4) The judgments of teachers indicate that descriptive grammar is suitable for a wide range of students and is more helpful in improving student writing and student morale than is traditional grammar. Research is needed to examine the validity of these judgments and to test the hypothesis that a positive relationship exists between knowledge of descriptive grammar and improved student writing and speaking.

Implications of this study are that teachers of English should become familiar with past and current research on language, with descriptive grammar and other branches of linguistic science; that teacher-training institutions should widen their scope of offerings to provide such training, and that a revitalized, soundly-based curriculum in English should be founded on new and established concepts about language.

Microfilm \$2.70; Xerox \$9.45. 207 pages.

GUIDING THE TEACHER TRAINEE'S
DEVELOPMENT OF THE QUALIFICATIONS
OF AN EFFECTIVE TEACHER--WITH SPECIAL
APPLICATION TO THE BUSINESS TEACHER
(VOLUMES I AND II).

(L. C. Card No. Mic 60-1263)

Dorothy Elizabeth Crunk, Ed.D. Indiana University, 1959

Chairman: Elvin S. Eyster

That effective teaching is vital to the welfare and progress of mankind is commonly acknowledged, but qualifications basic to teaching effectiveness are not clearly identified and generally accepted. Clear identification of effective-teacher qualifications is necessary for sound direction of the program of teacher education and for other decisions based on definition of those qualifications.

Importance of attributes may vary according to the teaching situation, but certain qualifications should be identifiable as a body as those qualifications desirable to the profession of teaching and unique as a body to that

group.

Educators and laymen are critical of the teacher education program's results in guiding the achievement of trainees. The best practices are not widely known; practices are often inadequate or ineffective. Analysis of current best thought of individuals and groups recognized as leaders in the profession of teaching should furnish a basis for a valid list of qualifications for teaching results. A study of current best thought in special fields of education should furnish similar information for those fields.

The Problem

This problem is a study of progressive guidance, counseling, and evaluation of students in teacher education for attainment of those qualifications (knowledges, skills,

abilities, and personal qualities) important to effectiveness of a teacher, with special reference to the business teacher.

Procedure

The plan called for (1) establishing a frame of reference, drawn from the researcher's background and analysis of professional education literature; (2) developing a list, synthesized from current best thought, of qualifications important to effectiveness of a teacher; (3) applying this list to the business teacher; (4) framing a list of concepts of guiding, counseling, and evaluating students in teacher education for achievement of desired qualifications; and (5) applying these concepts to business teacher education. Each qualification and each concept named was discussed separately and supported by reason and by quotations from authorities in education. The qualifications and concepts formulated were compared to those desirable for the business teacher in order to identify qualifications and concepts distinguishable for business teachers.

Findings and Conclusions

The principal outcomes from this study were (1) a list of qualifications desirable for an effective teacher, (2) a list of concepts pertaining to guiding, counseling, and progressively evaluating teacher trainees toward attainment of the qualifications of an effective teacher, and (3) application of these two lists to the business teacher. Qualifications of an effective teacher were formed into four classifications: (1) professional qualifications, (2) professionally related qualifications, (3) general education qualifications, and (4) personal qualifications. Concepts were presented in eight categories: (1) philosophy and objectives, (2) recruitment counseling, (3) admission, programming, registration, and orientation, (4) qualities and kinds of developmental experiences, (5) selection of developmental experiences, (6) progressive evaluation of the trainee's attributes and growth, (7) withdrawal, certification, placement, and follow-up, and (8) organization--planning, records, communication. Qualifications and concepts of an effective business teacher have not been distinguished to any appreciable extent from those desirable for any effective teacher.

Defensible effective-teacher goals and methods of achieving them must form the bases for a sound program of teacher education. Analysis and synthesis of informed opinion provides defensible goals and methods for teacher education in America today. Analysis must be continuous to find these answers for tomorrow.

Microfilm \$15.00; Xerox \$53.55. 1190 pages.

TEACHER EVALUATION OF THE NATURE AND EFFECTIVENESS OF IN-SERVICE TEACHER EDUCATION IN SELECTED SCHOOL DISTRICTS

(L. C. Card No. Mic 60-1334)

Mearl F. Gerheim, Ed.D. University of Pittsburgh, 1959

The purpose of this study was to identify current practices of in-service teacher education employed in selected school districts and to determine their effectiveness in helping teachers meet their professional needs.

The elements of this evaluative study were: (1) identification of current practices of in-service teacher education found in the literature; (2) teacher evaluations of the extent to which these practices were employed; (3) teacher evaluations of the effectiveness of the practices employed; (4) teacher evaluations of the potential effectiveness of practices they feel should be employed; (5) emerging practices and their implications.

The normative-survey method of research was used, developed through analysis of the literature, survey of superintendents, and questionnaires and personal interviews with teachers.

Analysis of the literature indicated six categories of in-service teacher education practices—resource personnel, staff relationships, improvement of instruction, community relationships, teacher participation in administration, and devices to implement the practices.

Participation, data concerning the districts, and the nature and number of resource personnel employed were sought by letters to superintendents in third-class school districts in the western half of Pennsylvania. Seventy of the 83 responded.

Questionnaires to teachers requested personal and professional data, and listed 80 practices, arranged as a three-point evaluation of the extent to which each was employed. Replies were quantified and scores computed for each practice, teacher, and district. The 20 districts having the highest average scores were considered as promoting the most extensive in-service programs and were thus selected for intensive study by interview.

Personal interviews were arranged with four teachers in each of the 20 districts. A check list was used, modeled on the questionnaire, providing for four-point evaulations of each practice, both in actual and potential effectiveness. Evaluations were tabulated and quantified, the computed scores indicating the most effective and preferred practices.

Findings, presented through a series of tables, indicated that teachers accepted and valued in-service programs planned carefully, locally, and cooperatively, but rejected those poorly planned or authoritatively imposed. In general, practices employed most extensively were those which teachers judged had been and could be most effective toward teacher growth. Among the six categories, practices promoting staff relationships and teacher participation in administration were judged most effective. Teachers favored resource personnel who helped them learn children over those who helped in teaching them. Among practices promoting staff relationships, they valued most those providing time and opportunity for participation and leadership by teachers. Most enthusiastically favored were opportunities afforded teachers to select their

instructional materials, coordinate curricula, prepare supply and equipment lists, help with building plans and school calendar, and work in peer groups to improve instruction. Workshops and study groups were judged the most effective in-service devices.

Teacher evaluations supported the conclusion that teachers are improved by the cooperative sharing of ideas. Hence, local districts should promote in-service practices which teachers consider effective, and provide opportunities for all to participate. There is need for resource personnel to help teachers understand their pupils, and to assist kindergarten teachers. Teachers want more experience in group dynamics, and to plan and preside at teachers' meetings. Lack of time in the school day and year proves a handicap to teacher growth. Community relationships, exchange teaching, and reading lists are ineffective toward teacher growth. Visitation is most effective outside the employing district. There is need for greater participation by teachers in selection, orientation, and promotion of personnel, as well as in budget-making, building plans, and making school calendars.

In general, according to teacher evaluations, modal practices of in-service education are cooperatively planned, noninspectorial in nature, and represent those most effective, while the least effective practices are employed least.

Microfilm \$3.90; Xerox \$13.75. 303 pages.

FAMILY OCCUPATIONAL STATUS OF
ELEMENTARY PUBLIC SCHOOL TEACHERS
AND DIFFERENTIAL BEHAVIOR OF
TEACHERS TOWARD CHILDREN OF
DIFFERENT OCCUPATIONAL STATUS FAMILIES

(L. C. Card No. Mic 60-1305)

Joseph Wesley Hart, Ed.D.
North Texas State College, 1960

The problem with which this investigation was concerned was that of determining whether elementary public school teachers who have been upwardly mobile occupationally are more helpful to children of lower and upper occupational status families than teachers who have not engaged in upward occupational mobility.

A review of the literature concerning teacher status, teacher background and classroom climate influences on learning gave an indication that it would be in the classroom of the dominative (authoritarian) teacher that the child of poor occupational background would suffer most.

The basic plan undertaken in the present research was to compare a selected group of non-mobile teachers with regard to behavior toward children of various occupational levels. An attempt was made to match the two groups of teachers in terms of number of years of teaching experience, age, size of class, and kind of degrees held. This matching was done in order that statistically significant differences that might be found between the two groups could be assumed to not be associated with things other than social origin.

Two instruments were used for gathering data. They were the McGee modification of the Anderson-Brewer Socially Dominative-Socially Integrative Observation Scheme, and the North-Hatt Scale for the ranking of occupations.

An analysis of the data indicated that there was no significant difference in the amount of attention either group of teachers gave occupationally high and occupationally low students. Both groups of teachers were more integrative toward high status students and more dominative toward low status students. Mobile teachers were comparatively more dominative toward the low status students.

The findings of this study were discussed according to the similarities and differences in the behavior of the two groups of teachers.

Considering the findings of this study, the implications of the findings, and the limitations of the study, the conclusions reached are as follows:

- 1. Low occupational origin tends to affect the observable behavior characteristics of teachers toward children from lower occupational status homes.
- 2. The mobile teacher is more dominative toward the low status pupil.
- 3. The behavior of the mobile teacher is such as to create a climate less conductive to "good" mental health and learning for students from lower occupational status families.
- 4. The differences in the behavior of the two groups of teachers seemed to be differences in degree, not in kind.

In the light of the foregoing conclusions, the following recommendations are made:

- If teachers are to work with the lower-class child on the basis of full understanding they must become aware of the social structure of their society and receive systematic instruction in the identification of social classes and the "norms" of social class behavior.
- 2. Perhaps it is the job of the institutions concerned with the preparation of teachers to re-examine their policies in regard to the recruitment and preparation of prospective elementary teachers.
- 3. In the recruitment program selection should probably be a continuous process. More attention should be given to the personality characteristics of prospective teachers.
- 4. An adequate number of qualified counselors should be provided for individuals preparing to enter the teaching profession.
- 5. Teacher preparing institutions might provide a program which emphasizes sound emotional growth as well as academic proficiency.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

PREPARATION OF MATHEMATICS TEACHERS
FOR PUBLIC TWO-YEAR COLLEGES IN
NEW YORK STATE: A STUDY OF SELECTED
FACTORS IN THE EDUCATIONAL PROGRAMS
OF PUBLIC TWO-YEAR COLLEGES IN
NEW YORK STATE THAT RELATE TO
THE PRE-SERVICE PREPARATION OF
MATHEMATICS TEACHERS FOR THESE COLLEGES.

(L. C. Card No. Mic 60-1115)

Charles Wesley Laffin Jr., Ed.D. New York University, 1959

Purpose

The purpose of this study was to analyze selected factors in the educational programs of public two-year colleges in New York State with relation to their significance for the pre-service preparation of mathematics teachers for two-year colleges.

The study was deemed necessary because of the increasing extent and significance of the two-year college in higher education and the accompanying increasing demand for adequately prepared teachers.

Methodology

Factors selected as bearing directly on the problem were: the current mathematics course offered in the two-year colleges; the educational background of currently enrolled full-time students; requirements for appointment and conditions of employment of mathematics teachers; and the judgments of teachers and supervisors in the public two-year colleges relative to appropriate pre-service preparation of mathematics teachers in these colleges.

The study utilized an occupational analysis technique based on the normative survey method of research. Four instruments, a questionnaire and opinionnaire for mathematics teachers, a questionnaire for administrators and a student data form elicited basic data.

These data were treated statistically to ascertain means, extremes, and patterns of central tendency. The investigator supplemented this information through visits and interviews at the colleges participating in the study. Seventeen colleges, forty-five mathematics teachers, seventeen supervisors, and 4,941 students were involved in the research.

Findings

Findings of this study were as follows:

- 1. The primary objectives of the mathematics programs are to develop skills and knowledge of mathematics applicable to certain technical employment and the general education of students, or to prepare them for further higher education.
- 2. The students in these colleges are largely enrolled in technical terminal programs, with Electrical, Mechanical and Construction Technologies and Secretarial or Office Services being the most popular. The students' over-all high-school averages were between seventy and eighty placing them in the second or third quartile of the graduating class. Nearly seventy-five per cent are males in the eighteen or nineteen year old age category.
- 3. The mathematics teachers typically hold a master's degree with additional work toward a doctorate, as an

educational background with a mean number of credits in mathematics of 44.1. Seventy three per cent had taught prior to the present position, and eighty per cent reported some prior non-academic work experience.

4. Teachers and supervisors recommend student teaching, teaching or practical experience, and applicable professional education as preferred pre-requisites for employment.

5. While considerable material has been written on the topic of desirable preparation for teaching positions in two-year colleges, research studies in this field are few in number.

6. Appropriate pre-service programs for mathematics teachers in two-year colleges are not readily available in the geographical area of recruitment encompassed in the study.

Conclusions

It was concluded that mathematics teachers in public two-year colleges of New York State require a pre-service program of preparation different in many respects from that for other levels of education. This study indicates that within presently existing programs of teacher preparation in teachers colleges, colleges and universities, curriculum patterns can be devised leading to competency as a faculty member in community colleges, junior colleges, and technical institutes. These programs should encompass guidance materials indicating career opportunities, appropriate emphasis and coverage in the major and minor fields of study determined by the nature of mathematics material to be taught, and professional preparation which includes attention to the role and philosophy of the twoyear college. Its distinctive aims, objectives, and teaching problems should be known and appreciated by prospective teachers. Microfilm \$4.25; Xerox \$14.85. 330 pages.

THE CERTIFICATION OF HIGH SCHOOL TEACHERS OF THE ACADEMIC SUBJECTS

(L. C. Card No. Mic 60-1413)

William Andrew McKenney, Ph.D. The Florida State University, 1960

The purpose of the study was twofold: (1) to develop a set of basic principles concerning the certification of high school teachers of the academic subjects; and (2) to determine the level of agreement on these principles among selected groups comprising the teaching profession.

Fourteen principles (many with sub-parts) were developed from the professional literature relating to the certification and teacher education. These principles were organized into an opinionaire. Judgmental responses were sought from 335 high school teachers of the academic subjects and 173 administrators. Usable responses were received from 65 per cent of those polled.

Levels of acceptance were defined as follows: a proposal receiving a favorable response from 70 per cent or more of the jury was considered highly acceptable; a proposal receiving a favorable response from more than 50 per cent but less than 70 per cent was considered acceptable; and a proposal receiving a favorable response from less than 50 per cent was unacceptable.

All proposals pertaining to the purposes of certification as set forth in the study were highly acceptable to both teachers and administrators.

Teachers and administrators were in essential agreement concerning the placement of legal authority for certification.

Both groups accepted the proposals that both the major academic department and the professional Education department of the training institution should endorse the candidate for the certificate.

The judgments of teachers and administrators concerning the types of certificates were somewhat more varied. Generally both accepted the proposals set forth in the study which advocate three levels of certificates: probationary, provisional-professional, and professional. There were significant differences with respect to some of the proposed requirements for the certificates.

Both groups were in essential agreement with proposals pertaining to the standards for certification and related proposals about the accreditation of teacher education programs.

Teachers and administrators differed, sometimes significantly, over the details of the proposals, but the overall pattern of acceptance-rejection was similar. In only a few instances was there a strong acceptance of a proposal by one group and rejection by the other.

The respondents as a whole did not favor (1) the inclusion of laymen in the making of certification policies, (2) the examination as a means of achieving professional level certification, and (3) the denying of certificates to graduates of institutions with non-accredited teacher training curricula.

Administrators did not accept the principle that school officials should be required to place teachers only in positions for which they are certified and that professional level certificates should be renewed automatically. Teachers did not accept the principle that high school teachers of the non-academic subjects should take part in the policy making for certification of teachers of the academic subjects. Teachers also excluded professors of the arts and sciences from decisions concerning general policy and professors of Education from decisions pertaining particularly to subject-matter requirements for certification.

There was considerable evidence that public school educators are concerned in a professional way with problems and policies of certification as they affect all school personnel including teachers of the academic subjects and their patronage.

Microfilm \$2.70; Xerox \$9.25. 205 pages.

A COMPARATIVE STUDY OF CRITICAL INCIDENTS TO DETERMINE RECOMMENDED TECHNIQUES FOR SUPERVISORS OF STUDENT TEACHERS

(L. C. Card No. Mic 60-1321)

Merrill S. Nicklas, Ed.D. University of Arkansas, 1960

Major Professor: R. K. Bent

I. THE PROBLEM

The purpose of this study is to determine effective and ineffective techniques relative to the supervision of student teachers, and the extent to which supervisors and student teachers agree on these techniques.

II. PROCEDURE

The investigation was divided into two rather distinct parts: (1) the first part employed the critical incident technique as a systematic method of collecting descriptions of supervisory techniques by analyzing effective and ineffective incidents of supervisory aid as reported by supervisors and student teachers; (2) a list of twenty-four incidents, representing fifteen supervisory techniques, comprised the questionnaire for the second part of the study, supervisors and student teachers being asked to judge the degree of success that they thought would result from the supervisory methods illustrated by these incidents.

III. POPULATION, SAMPLE, AND DATA COLLECTION

The first part of the study was limited to a selected sample of colleges and universities from a five state area: Texas, Arkansas, Oklahoma, Missouri, and Louisiana. Using the supervisors and student teachers of seven schools from these states as a population, the sample consisted of 100 supervisors and 225 student teachers.

The membership of the Association of Student Teaching was designated as the population for the second portion of the study. The sample consisted of every fourth member who was listed as a supervising, cooperating, or critic teacher. Each of these 200 supervisors was asked to give the questionnaire to one of his student teachers; the sample, thereby, consisted of 200 supervisors and 200 student teachers.

IV. STATISTICAL ANALYSIS

The chi-square test was used to determine the relationship between certain paired variables. Forty-eight chisquare values were computed to test for significant differences between returns from student teachers and supervisors and to test the reliability of test items.

V. FINDINGS

The most significant results of the investigation were:

1. Both supervisors and student teachers approved the private conference, group conference, teaching demonstrations, special aids and information, special duties, methods classes, taped recordings, and the use of compliments as effective supervisory techniques.

- 2. Both supervisors and student teachers disapproved the employment of classroom interruptions, outside of class aid for pupils by the supervisor, issuing directives, and leaving the solution to the student teacher.
- 3. Although there were differences with respect to the degree of approval, supervisors and student teachers were in agreement on all techniques when these returns were appraised on an approve-disapprove basis.
- 4. The private conference proved to be the most popular supervisory device.
- 5. There was an indication of insufficient use of tape recordings and complimenting the student teacher.

VI. RECOMMENDATIONS

- 1. The techniques of private conference, group conference, teaching demonstrations, special aids and information, special duties, methods classes, tape recordings, and the use of compliments are submitted as recommended procedures, their employment depending upon varying factors of the situation.
- 2. The techniques of classroom interruption, outside of class aid for pupils, issuing directives, and leaving the solution to the student teacher should be submitted to further analysis by the supervisor, and they should be used with caution.
- 3. If the critical incident technique is to be employed in a similar study, an attempt should be made to increase the variability of the returns from the sample.
- 4. Additional research is needed within the area concerning techniques of supervising student teachers.
- 5. The use of the private conference, tape recordings, and complimenting and showing dependency in the student teacher are especially recommended.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

SURVEY OF CHANGES IN FUNCTION OF THE COLLEGE-CONTROLLED LABORATORY SCHOOL FROM 1948 TO 1958

(L. C. Card No. Mic 59-6285)

Lawrence Howard Nuzum, Ed.D. The University of Tennessee, 1959

Major Professor: Orin B. Graff

This study has attempted to determine what changes in function have taken place in the college-controlled laboratory school during the period from 1948 to 1958.

The three major sources used to provide data for the study were: review of related literature, case studies made through visits to ten selected college-controlled laboratory schools in a six state area, and results of a survey questionnaire sent to college-controlled laboratory schools in forty states and the District of Columbia.

The development of the laboratory school was presented in terms of original purposes and modern concepts. The implications for possible changes in function were reviewed in relation to purposes and goals of the teacher education program. Current literature, related studies and findings were presented in tracing the laboratory school program; its past and present function.

The method used in the application of the case study technique was explained. The construction and use of the interview guide employed in the collection of data were presented to show its use in organizing the case study approach.

The development and use of the survey method were disclosed as the best means to obtain necessary data concerning the laboratory school program in the United States. The construction and content of the survey questionnaire were based on the information derived from related studies and the case study visits. Schools were selected for this part of the study from a listing of the American Association of Colleges for Teacher Education.

Several important changes in function were revealed through data derived from the three major sources used in the study. More experiences prior to student teaching were being offered in this type school in 1958. These experiences were being offered in more years of the college sequence than in 1948.

Less student teaching was being provided in college-controlled laboratory schools in 1958. The provision for a teaching experience prior to the regular student teaching experience was not verified as a trend. Post-student teaching experiences had made little progress in becoming a part of the laboratory school program. Post-student teaching was making little headway as an accepted function in this type school.

Laboratory experiences had assumed an integral place in the four year preparation program for teachers. These experiences had become an important part of the work of each year in many of the schools.

A more cooperative effort involving laboratory school and college staff members in assigning students to laboratory experiences in the laboratory school was reported by a majority of schools. Little progress was indicated, however, in consideration of individual differences when making these assignments.

Guidance of laboratory experiences did not verify a definite trend in respect to the responsibility for this function in the laboratory school. Supervision of experiences prior to student teaching continued to be the responsibility of the laboratory school teacher. The trend in supervision of student teaching and post-student teaching experiences was not clearly defined in the major data of the study.

Experimentation in the laboratory school was being emphasized more as a function in 1958. The areas receiving most attention through experimentation were curriculum and teaching methods.

Using the laboratory school for research was not reported as a major function by most schools. Efforts being made in this direction were concerned mostly with curriculum and evaluation.

The study of the area of special services provided by the laboratory school shows a significant trend toward more observation of educational practices by foreign students. Laboratory school teachers seemed to find little time to write and publish articles for publication.

The teaching of special methods courses by laboratory school teachers was not revealed as a major change in function. Some schools were openly opposed to the inclusion of this function due to the demands placed upon the teacher in meeting the needs of the laboratory school student.

Local school systems were receiving major assistance from the laboratory school in some areas. Laboratory school teachers were also providing greater service as leaders and consultants for professional meetings. Little attention, however, was being given to the provision for follow-up service to the beginning teacher in the local school system. Microfilm \$2.50; Xerox \$8.00. 171 pages.

A STUDY OF FACTORS WHICH AFFECTED HIGH SCHOOL SENIORS' INTEREST IN SCIENCE

(L. C. Card No. Mic 60-1415)

Tully Sanford Pennington, Ed.D. The Florida State University, 1960

The purpose of this study was to identify factors which affected high school students' interest in science. The survey-analytical method of research was used. Data were obtained from printed questionnaires completed by 502 of the 1040 high school seniors in the First Congressional District of Georgia during the 1955-56 school year. The questionnaire was administered in selected classes of required English courses in ten of the twenty-eight high schools of the district.

The hypotheses of the study proposed certain factors, frequently associated with the study of science, did not influence students' interest in science. The factors considered were: occupation of parents, community background, vocational choice, membership in science-related organizations, science-related hobbies, science-related television and radio programs, age and first interest in science, scientific reading, opportunity to participate in science-related activities, part-time jobs, personal and professional qualities of teachers, subject matter quality, organization of science courses, instructional methods and materials, courses in mathematics, and guidance.

Of the 502 students questioned, 300 (60%) were interested in science and 202 (40%) were not interested in science. The expected number of students reporting on a given factor was determined by use of the above percentages.

The occupations of parents of the population studied had little effect on the students' interest in science. Certain residence backgrounds and vocational decisions definitely influenced students' interest in science. Interest in science gained through part-time jobs did not appear to be lasting. The likelihood that students would be interested in science was greater than expected if they had been members of science-related organizations, spent time weekly on science-related hobbies, and frequently enjoyed science-related radio and television programs. Students who were interested in science had read much more from a greater variety of sources than students not interested in science.

Certain factors associated with school experiences appeared to have influenced students' interest in science. Larger percentages of students interested in science than expected reported their interest in science had been stimulated by good teaching. Enthusiastic, well prepared teachers, who took a personal interest in their students, provided opportunities for participation in activities during and after school hours favorably influenced students' interest in science. Participation in science club and science fair activities favorably affected students' interest in science although few reported participation in these activities. Only 17% of the population had been members of science clubs. Twenty-seven percent of the population studied had

worked on science fair projects. Thirty-five percent had attended a science fair. Nineteen percent had exhibited at a fair. A district science fair had been held annually for four years prior to the study and a state fair had been held for seven years prior to the study.

The organization of science courses and teaching methods affected students' interest in science. Good use of bulletin boards and well planned field trips favorably affected interest in science. Students were more likely to be interested in science if they had the opportunity of working in well equipped laboratories.

Students who had more than the required science courses and four courses in mathematics were most likely interested in science. General science and biology courses were available to the total population studied. Of these, 481 took general science and 355 took biology. A course in chemistry was available to 433 of the students. Of these, 172 took the course. Physics was available to 434 students of the study, but only 94 of them took the course. Consequently, four science courses were available to 86% of the population studied.

Microfilm \$2.60; Xerox \$9.00. 199 pages.

A STUDY OF THE RELATIONSHIP BETWEEN
SELECTED CHARACTERISTICS OF
DIFFERENTLY ORGANIZED JUNIOR HIGH
SCHOOLS AND THE CONCEPTS OF SELF AND
OTHERS OF THE PUPILS AND
TEACHERS IN THESE SCHOOLS

(L. C. Card No. Mic 60-1416)

Robert L. Shannon, Ed.D. The Florida State University, 1960

This study was an attempt to establish understandings of how certain aspects of junior high school pupils' school experiences are related to the concepts of self and others developed by the pupils. Determination of whether or not a particular kind of school organization is more effective in educating students to be self-accepting persons and who perceive others in their peer group to be self-accepting persons was the primary focus of the investigation.

Five junior high schools in three Florida cities were selected as participating schools. Student subjects from these schools numbered 2,626 and represented grades seven, eight, and nine. Ninety-three teachers from the five schools composed the teacher cases for the study.

The following factors were examined as they relate to students' self-acceptance and their perceptions of peers' self-acceptance:

- 1. Curriculum organization
- 2. Socio-economic status
- 3. School-community
- 4. Teachers' self-others concepts and their teaching procedures.

Findings

Socio-economic status and self-others concepts of junior high school students were found to be essentially

unrelated. A slight relationship was measured at the .10 level.

The relationship between the school-community and the students' self-others concepts was not significant. Certain of the findings, however, suggest that these school-communities are definitely diverse in the degree of success they have in developing persons possessing the various perceptual qualities.

This research revealed that there is not a significant relationship between the teaching techniques used by a teacher and the students' development of perceptions of self and others, providing the teachers are all persons who accept themselves and others.

Teachers who accept themselves and perceive others in their peer group to be self-accepting persons seem to use democratic teaching procedures more frequently than do teachers who do not have such perceptual qualities. According to the findings of this research a teacher who does not accept self, but perceives others to be more self-accepting of themselves will tend to use autocratic teaching procedures more frequently than will the teacher who perceives self and others positively. The teaching methods employed by a teacher appear to be related to the self-others concepts of that teacher.

A significant relationship was found to exist between these junior high school students' self-others concepts and the kind of curriculum organization which they experience. At the junior high school level the self-contained classroom appears to be more productive of persons who accept themselves and perceive others to be self-accepting persons than are either the departmental or the block-departmental organizations. The departmental design seems to be less successful than either the block-departmental plan or the self-contained classroom types of curriculum organization in producing junior high school students who possess positive perceptual qualities.

The junior high schools participating in this study were found to be unsuccessful in enabling the majority of the students to be self-accepting persons and who perceive peers to be equally self-accepting. Implications of this research suggest that a student's self-acceptance and his perceptions of peers' self-acceptance are measurably influenced by certain characteristics of the student's school experience. Microfilm \$2.50; Xerox \$5.80. 118 pages.

THE PROFESSIONAL PREPARATION OF ELEMENTARY SCHOOL TEACHERS IN IRAN

(L. C. Card No. Mic 59-6288)

Ali Shariatmadari, Ed.D. The University of Tennessee, 1959

Major Professor: Philip G. Smith

The purpose of this study was to investigate the present professional program of teacher education for elementary school teachers in Iran with special attention given to the principles or theory of the elementary school curriculum. Emphasis was placed on an analysis of responses of elementary teachers (graduates of the program) to a questionnaire designed to reveal their understanding of the basic principles and purposes of the elementary school curriculum

Since the instructional materials, curriculum, and standards of all elementary teacher education institutions are the same in all the provinces, it was assumed that a single institution provides reliable data upon which to base sound conclusions. A single elementary teacher education institution was selected for study, namely, the Normal School in Shiraz, the major city of the province of Fars.

This study was limited to about 65 per cent of the total elementary teachers (men) in Shiraz who had completed the program of the Normal School in this city. There were seventy four such teachers. Fifty of these teachers were selected at random and asked to complete the questionnaire. Forty-five completed and returned the questionnaire.

The present program of the Normal School includes a two-year program after ninth grade. The professional part of this program consists of three courses, educational psychology, education, and ethics. Students are required to have three hours of educational courses per week in the first year—two hours of educational psychology and one hour of education. In the second year, students must have one hour of education (method of teaching) during the whole year, one hour of educational psychology in the first half of the year, and one hour of ethics in the second half of the year. Also, students must have five hours of teaching practice per week in the second year, but the total amount of teaching practice must not be more than 160 hours per year.

The theoretical aspects of school curriculum, as presented in the textbook used in the education course, includes a discussion of the social purposes of education and a very brief discussion of principles in preparing the school curriculum.

The responses of the elementary school teachers concerning the basic issues of the school curriculum seem to indicate that in general most of these teachers lack:

- A clear-cut understanding of the basic factors involved in the learning process.
- Knowledge concerning the various aspects of the child growth and development.
- 3. Understanding of the characteristics of the Iranian society.
- 4. A full understanding of the general purpose of education and educational objectives of the elementary school in Iran.
- Knowledge and understanding concerning the criteria of selection and organization of the school curriculum.

Based upon the findings of this study some of the recommendations are:

- 1. The areas that should be included in the Normal School program are: (a) child growth and development, (b) educational psychology including learning theories and evaluation, (c) introductory philosophy of education, (d) curriculum theory, (e) guidance and counseling, and (f) scientific method and its use in class situations.
- 2. The Ministry of Education should elevate the Normal School from the secondary level to college level.
- There should be an in-service education program for elementary school teachers and the Normal school instructors designed to help them to understand the basic issues of the school curriculum.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

EDUCATION, THEORY AND PRACTICE

TEACHERS' UNDERSTANDING OF GROUP BEHAVIOR

(L. C. Card No. Mic 60-1306)

Mary Abbie Bany, Ed.D. University of Southern California, 1960

Chairman: Professor Naslund

The problem with which this study was concerned was to explore the extent of elementary teachers' understanding of classroom group behavior and their knowledge of ways to achieve change in groups.

The study was directed toward the following specific areas of inquiry: (1) the nature of classroom group behaviors which teachers said were difficult to control or guide, (2) the practices or controls which teachers believed were best to use when group behavior problems arose in classrooms, and (3) the extent of teachers' understanding of group behavior and the extent of knowledge of ways to achieve change in groups.

The investigation included (1) a survey of the literature to obtain research findings and authoritative opinion, (2) the use of the critical incident technique to obtain descriptions of classroom group behaviors teachers said were difficult to control or guide, (3) the development of a free-response questionnaire containing incidents of problem group behavior to discover teachers' proposed "best" practices for guiding or controlling the behavior described, and (4) a comparison of teachers' responses and direct statements with the findings obtained from the survey of the literature.

The critical incidents of classroom group behavior problems were described by 263 experienced elementary teachers who were attending advanced education classes in three colleges in or near the city of Los Angeles. A total of 738 incidents were categorized and analyzed as to the specific nature of classroom group behaviors which were difficult to control or guide.

Another 312 experienced elementary teachers who were attending advanced education classes in three universities or colleges responded to the questionnaire based on the data from the critical incidents. The practices proposed as "best" when certain incidents of group behavior arose in classrooms were categorized as (1) punitive or threatening, (2) divertive or ignoring, (3) dominative or pressuring, (4) cooperative or directing, or (5) other practices.

Finally, the nature of the responses of the total 575 teachers was analyzed and compared with findings from research.

Conclusions. (1) From the evidence it appeared that teachers lack the understandings and skills necessary to develop goals and standards with groups. (2) Teachers do not recognize the potential of some situations for using problem-solving processes. (3) Many teachers fail to understand that use of group process or group decision may change group attitudes and behavior. (4) Teachers lack knowledge concerning ways to create a social climate in which pupils may exert initiative and develop self-discipline. (5) The study suggests that teachers lack knowledge of ways to help groups face unforeseen situations. (6) When undesirable group behavior occurs, teachers are apt to resort to

leadership practices which utilize power instead of skill. They appear to have little or no insight into the cause of the behavior or the problem involved and therefore resort to authoritarian practices. (7) Amount and kind of experiences in working with classroom groups do not increase teachers' insights into the factors influencing group behavior nor understanding of effective practices. (8) A lack of understanding of group characteristics and of factors influencing behavior indicates that many teachers are unable to provide the best environment for learning. (9) The lack of understanding of effective practices implies that many teachers are unable to guide groups in ways consistent with a democratic philosophy.

Recommendations. A further detailed study of the group behavior problems which occur in elementary class-rooms is needed. Differences between the group behaviors perceived by teachers as problems and actual classroom group behavior need examination. There should be emphasis in teacher education on the importance of mutually determined task-goals and their place as determiners of group behavior, on group problem-solving and the processes involved, and on the kinds of problems which may be clarified by group problem-solving processes.

Microfilm \$6.05; Xerox \$21.40. 474 pages.

THE ACADEMIC DEAN AND HIS ROLE IN THE IMPROVEMENT OF INSTRUCTION

(L. C. Card No. Mic 60-1304)

Cletis Theodore Eskew, Ed.D. North Texas State College, 1960

The purpose of this study was to determine changes in practices and beliefs which would be needed by certain academic deans to provide a sound program for the improvement of instruction. The study was divided into three subdivisions: (1) to determine some criteria for the evaluation of the practices, (2) to analyze existing practices and their acceptances, and (3) to propose a program of evaluated practices which might constitute an effective means for the improvement of college instruction.

Data were obtained from the professional literature and an information schedule sent to selected colleges and universities in the United States offering the master's and/or second professional degrees. Seventy-eight per cent of the academic deans in the 219 institutions responded.

Chapter I introduced the study and stated the problem, suggested the sources and procedures for treatment of the data, and summarized related studies. Chapter II discussed the need for criteria to evaluate the practices, explained the methods by which they were formulated, and stated the criteria. Chapter III described the procedures used for developing the instrument that was employed to obtain the deans' judgments, reported on the responses received, and analyzed these responses. Chapter IV dealt with the application of the criteria to the practices and the proposed program. Chapter V gave the summary, conclusions, and recommendations.

Nine criteria were formulated within psychological, sociological, and democratic frames of reference and

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were validated by related research studies and statements of leaders in the field of educational thought.

Some of the major findings of this study were as follows:

(1) two new practices for improving instruction were reported that were not found in the literature examined,

(2) there were marked differences in the number of practices used and their evaluations by the academic deans responding,

(3) there was widespread interest in improving instruction,

(4) there was considerable agreement between this and related studies,

(5) practices used were rated higher by the academic deans than the ones not used by them,

(6) reward for good teaching was rated the most effective practice for improving instruction,

(7) evaluation of teaching seems to be perfunctory, and

(8) there is need for leadership in promoting programs designed to improve instruction.

The principal recommendations of the study are listed in the following statements. Colleges and universities interested in improving instruction should: (1) identify and study the problems to be attacked, (2) provide for maximum faculty participation in the planning and implementing of the program, and (3) promote and provide conditions as stated in the criteria.

Eighteen practices constitute the proposed program which academic deans might use for the improvement of instruction in their institutions. These practices are summarized as follows: (1) faculty guidance, (2) course outlines, (3) institutional self-studies, (4) voluntary seminars for exchange of ideas, (5) summer travel and study, (6) leaves of absence with pay for advanced study, (7) membership in learned societies and attendance at professional meetings, (8) clerical help for faculty, (9) materials for instruction supplied in line with need, (10) adjustment of teaching loads, (11) research in institutional methods, (12) adjustment of class size, (13) help of department heads in matters of instruction, (14) participation of faculty in the determination of institutional policies, (15) selection of new faculty members, (16) acknowledgment of superior teaching, (17) academic freedom, and (18) encouragement and interest from administration.

Four related problems were recommended for further study. Microfilm \$3.20; Xerox \$11.25. 246 pages.

THE STATUS OF GEOGRAPHY IN THE PUBLIC SENIOR HIGH SCHOOLS OF CALIFORNIA

(L. C. Card No. Mic 60-1347)

Willard Eugene Gandy, Ed.D. Stanford University, 1960

The purpose of this study was to determine the status of geography in the public senior high schools of California both quantitatively—the amount and kinds of geography offerings—and, to an extent, qualitatively. Factors affecting the qualitative status are seen as the educational level, preparation in geography, and experience of geography teachers. Their attitude towards the subject they teach and the materials with which they have to work also influence the quality of instruction.

The schools of California offering geography as a separate course were determined by analyzing the October Reports in the State Department of Education, Sacramento, California. These Reports are required of each public

high school and reveal the course offerings of each high school and the nature of the courses, e.g. length, emphasis, basis for enrollment and grade level offered.

Each school offering geography was then categorized by its location: rural (under 250 population), urban (2500-100,000 population), or metropolitan (over 100,000 population) and by its size computed from average daily attendance figures. From the categories thus established, a ten percent sampling (selected randomly from a sampling restricted in area to a radius of 125 miles around San Francisco) was taken. All the geography teachers (38) in these eighteen high schools were interviewed to determine the nature and number of the geography classes they were teaching, their educational level, preparation in geography, number of years of teaching and background in foreign travel. The teachers of the survey were also queried on items which reflected their opinions of geography; their perception of needs and problems in geography; the methods, techniques and devices utilized in teaching geography; the perception of the adequacy of audio-visual materials and their use of such material; and the adequacy of the supply of the instructional aids and materials within their school.

Data from the October Reports indicated one out of three high schools in California offered geography as a separate course either in a course with the word geography in its title, or in courses with a Social Studies title but the content of which was geography. The dominant course, World Geography, constituted 126 of the 183 courses.

Data from the survey indicated geography teachers to be alarmingly unprepared in the subject matter of geography. Of the teachers surveyed, 47.3% had no course work in geography; 76.5% had six semester hours or less course work in geography. Only one of the thirty-eight teachers surveyed had a degree in geography.

Fifty-six percent of the teachers had not asked to teach geography. Only three of the 38 teachers had taught geography more than five years. Forty-two percent were still opposed to teaching geography.

Other findings of a problem stature were the scarcity of instructional materials and aids, the relegation of geography courses to non-college preparatory students, and lack of evidence as to whether geographic learnings are best offered in separate or integrated courses.

The survey would indicate that geography is being offered in a surprisingly high number of high schools considering an apparent shortage of well prepared geography teachers. Improper utilization of teacher personnel by assigning unprepared teachers to geography classes is evident. The credentialing structure of California permits Social Studies teachers to teach geography without any preparation in geography. This contributes to the problem of ill-prepared geography teachers and to the improper placement of teachers. Colleges and Universities should assume responsibility for preparing an adequate number of geography teachers if the problem is to be alleviated or solved. Microfilm \$2.60; Xerox \$9.00. 200 pages.

CONSTRUCT VALIDITY IN ACHIEVEMENT TESTING: AN INVERSE FACTOR ANALYTIC STUDY OF THE MEANING OF ACHIEVEMENT FOR PROFESSORS AND STUDENTS OF PSYCHOLOGY.

(L. C. Card No. Mic 59-6242)

Esin Kaya, Ph.D. New York University, 1959

The purpose of the study was to test the assumption that, on an achievement test, the obtained variance is attributable to the construct variable achievement. The problem was to ascertain numerically the construct validity of achievement by determining the amount of agreement between examiners and examinees. If achievement has construct validity, examiners and examinees should agree in their use of criteria for judging the content validity of

test items for a general psychology test.

The sample consisted of 14 psychology professors, 14 high-achieving students, 14 low-achieving students, and five specialists in tests and measurements. All subjects were given a Q-sort consisting of 60 multiple-choice items from a general psychology test which was part of the institutional testing program of the Educational Testing Service. These items were controlled for difficulty and for item type. Each subject, in doing the Q-sort, judged which items were most and least relevant to a general psychology test. Each individual's sort was then subjected to an analysis of variance. In addition, intercorrelations were computed among all individuals and two types of factor analyses were done: a centroid factor analysis using all subjects; and three interbattery analyses - one between professors and high achievers, one between professors and low achievers, and one between high and low achievers.

The computations yielded the following results:

1. Individuals varied greatly in their choice of the items as relevant or irrelevant to a general psychology test. The lack of agreement among individuals applied to professors and students.

2. There were two clear factors on which both professors and students had high loadings. The first seemed to be a factor of "critical evaluation," the second a factor of "physiological-experimental orientation." The third factor did not have a very clear pattern. However, all subjects save one who had high loadings on this factor were students which suggested that it might be a "student factor."

3. The results of the interbattery analyses pointed to a fairly high construct validity for achievement. There were three factors common to all groups with all intercorrelations higher than .60. However, the construct variable is highly complex, as evidenced by the number of sig-

nificant factors in the interbattery analyses.

4. The factors of the professors' judgments of item relevance and the determinants of the high-achieving students' judgments of item relevance were highly correlated. The correlations on all five factors common to the two groups were higher than .60.

5. The factors of the professors' judgments and of the low achievers' judgments of item relevance were highly correlated. There were fewer common factors between professors and low achievers than there were between professors and high achievers.

6. The factors of high achievers' judgments and the factors of low achievers' judgments of item relevance

were at least as highly correlated as the factors of the judgments of either group with the professors. On one factor the two student groups agreed significantly more highly than either group alone agreed with the professors.

7. The repeat reliability indices for those individuals who did the Q-sort twice ranged from .78 to .87. This

seems to point to low error variance.

The study has tried to show the relation between content and construct validity. Construct validity has been treated as the basic type of validity which should not be assumed in the investigation of other types of validity, but should first be established through scientific verification.

Microfilm \$2.50; Xerox \$5.60. 113 pages.

A CONCEPTUAL APPROACH FOR BETTER UNDERSTANDING OF INDUSTRIAL SHOP WORK IN ONE-TEACHER INDUSTRIAL ARTS SHOPS

(L. C. Card No. Mic 60-1245)

Raymond Edri Matala, Ed.D. The University of Oklahoma, 1959

Co-Chairmen:

Associate Professor Charles S. Williams Professor Robert A. Hardin

The purpose of this study was to explore the possibilities of a conceptual approach to industrial arts teaching in the one-teacher diversified shops of Iowa with respect to the aim of helping the pupil gain an understanding of

industrial processes.

By means of discussions with 65 teachers of industrial arts in Iowa and with 15 college industrial art teachereducators in Iowa, a questionnaire of 16 items was devised to assess the climate in which the conceptual approach to industrial arts teaching in such schools might find itself. The discussions were oral and on a face to face basis with opportunities for those visited to ask questions. A sample concept (i.e. the cutting edge) was used for illustration, and representative concepts in the areas of industrial arts woodwork, metalwork, drawing, and electricity were identified and utilized. These representative concepts resulted from the discussions and from a survey of literature in the field.

The following conclusions were drawn from the study: There is a constant danger that industrial arts activities may not realize their full import in general education because of the physically active atmosphere of the school shop where "doing" predominates. The project, and the skill required in its fabrication, may easily dominate the scene. The main antidote for this is for the teacher to be encouraged to develop concepts in his shops on his own initiative. The manipulative activity in the shop will then become merely a means to achieving these ends and not become an end in itself.

Concepts can be discovered in the literature of industrial arts and of industry, but they seem much fewer in number than are informative items and descriptions of

High school shop teachers in Iowa are inclined to limit the number of industrial arts areas in their shops to the number they can effectively handle. Four typical areas are woodwork, metalwork, drawing, and electricity.

College teacher-educators in Iowa would prefer a greater number of areas than these four to give a better representation of industry, and to provide a wider range of experiences for the pupils.

The participants in the study believe that teaching by the concept method should be encouraged and developed. They also believe as many avenues for exploration as possible should be provided for the pupils in view of the expanse and complexity of our industrial society. They tend to agree that the number of areas attempted is a deeply personalized matter in which penetration for depth must be reconciled with the demands for broad coverage and broad industrial representations.

The participants are aware that industrial arts has certain unique functions in general education. Therefore industrial arts must integrate its activities with the whole school program so that it can discharge its unique functions effectively.

Industrial arts teachers are aware that many highly valuable aims of general education can subtly encroach upon the unique industrial connotation of industrial arts, making shop work more and more superficial in this respect.

Microfilm \$3.10; Xerox \$10.80. 240 pages.

THE SELECTION OF INSTRUCTIONAL MATERIALS FOR ELEMENTARY SCHOOLS IN CALIFORNIA

(L. C. Card No. Mic 60-1313)

Hilda Marie McCartney, Ed.D. University of Southern California, 1960

Chairman: Professor Naslund

The purposes of this study were (1) to ascertain procedures currently being used in California elementary school districts for the selection of supplementary text-books, library books, and audio-visual materials, (2) to determine the extent to which various school and lay personnel are involved in the selection process, (3) to compare practices and policies concerning selection procedures in school districts of similar size, (4) to analyze similarities of selection procedures among school districts of different sizes, and (5) to determine acceptable procedures as judged by individuals responsible for the selection of instructional materials.

Data were obtained by means of a questionnaire and opinionaire developed from (1) a review of related literature, (2) interviews with curriculum directors, county office personnel, librarians, teachers, and (3) analysis of selection policies, procedures, and criteria developed in individual school districts in California. Survey instruments were sent to administrators and supervisors in 349 California elementary school districts and to administrative personnel in 57 county offices; 302 responses were received, a 74.8 per cent return. Participating school districts were divided into five categories according to district size, the data tabulated, percentages computed, and results analyzed for likenesses and differences within and among district groups.

<u>Findings.</u> (1) The primary source for obtaining supplementary textbooks and library books was district purchase; for audio-visual materials it was the county schools

service. (2) Larger districts tended to house all instructional materials in a centralized depository or library, whereas smaller districts provided housing facilities in each school. (3) Larger districts tended to list instructional materials centrally, whereas smaller districts tended to list them in each school. (4) Committees were usually appointed for selecting and evaluating instructional materials of all types, although the curriculum department often performed this function. (5) Committees for evaluation and selection were usually composed of professional educators appointed by district administrators. (6) No general pattern of policy or practice existed for training committee members or for the selection procedures to be followed. (7) Few districts had formulated written statements of policy for selection procedures. (8) Small districts tended to spend more money per pupil than did large districts for the purchase of supplementary textbooks and library books but less money for audio-visual materials.

Conclusions. (1) California elementary school districts exhibit satisfactory selection practices with respect to wise allocation of budgets, wide involvement of professional personnel, integration of instructional materials with curriculum, choosing of instructional materials on the basis of merit, and teacher satisfaction with selections made. (2) Improved practices are needed with regard to tryouts of materials in classroom prior to purchase, hiring of professional librarians, efficient use of time in evaluation and selection of materials, formulation of written statements of policy, training of selection committees, and broader involvement of pupils and lay persons in selection procedures.

Recommendations. (1) Adequate time should be allowed for thorough evaluation of instructional materials. (2) Committee members should be given basic orientation and training in effective selection procedures through workshops, in-service training, periodic bulletins, directors' sessions, and preschool intensive training programs.

(3) Credentialed librarians should be hired to carry on library instructional programs and to participate in selection procedures. (4) Individual school districts should involve all personnel concerned in selecting instructional materials. (5) School districts generally should formulate written statements of policy and procedure for the selection of instructional materials for California elementary schools.

Microfilm \$7.35; Xerox \$26.10. 580 pages.

THE EFFECT OF TEACHER PARTICIPATION
IN CURRICULUM GUIDE DEVELOPMENT
UPON SELECTED CLASSROOM
TEACHING PRACTICES

(L. C. Card No. Mic 60-1348)

Abe Milstein, Ed.D. Stanford University, 1960

Statement of the Problem

The research reported in this study was undertaken to determine the extent and direction of changes in classroom practices which may be expected from the production of their own curriculum guides by teachers.

The assumption that teachers who develop curriculum guides gain knowledge of a wide variety of materials and more insightful methods for their classroom application needed documentation.

The investigation was one means of evaluating a course-of-study project involving classroom teachers in Marin County, California. By analyzing the classroom procedures of a group of teachers who worked on the guides and comparing these procedures with those of a similar group who did not, this study sought data from which conclusions may be drawn regarding the value of curriculum workshops as in-service education.

Procedure

The sample was comprised of two groups of teachers in arithmetic, social studies, and language arts in grades kindergarten through eight. Twenty-five teachers, who served in the curriculum guide committees, are identified as the experimental group. An equal number of teachers were matched for the control group. All subjects were selected by the same administrators, and were recognized as "competent" teachers. Antecedent variables such as extent of training and experience were also used in equating the groups.

The survey was restricted to dimensions readily observable within the classroom. An observation check-list was used to record data in the following dimensions: variety of instructional materials, differentiated use of materials from pupil to pupil, timeliness of materials, range in difficulty and maturity levels of materials, selection of materials, purposes served in the use of materials, variety of learning activities, and differentiated use of activities.

Subjects were observed three times for periods of onehalf hour. Some team observations were used as a check to verify the observer's perception and to assure the objectivity of the observational data. Personal interviews with the subjects elicited further information relevant to the study.

Findings

Experimental teachers testified that they had experienced professional growth as a result of their participation in the curriculum development project.

The observational data are reported in terms of the number of teachers in each group who used materials or practices more or less frequently than the median number used by all subjects. The significant findings, at or below

.05 level of confidence, were rare. In only three dimensions were significant differences between the groups obtained. These related to the use of certain materials in arithmetic and language arts in which experimental teachers used more "acceptable" practices than did others. Small differences, between .05 and .15 levels of significance, were obtained in fourteen other dimensions, in which eleven reflected superior teaching methods by experimental teachers and in three by control teachers.

Although significant and small differences were obtained in seventeen areas of measurement, more critical, it seems, is the fact that in sixty-seven other areas only slight or no differences were observed.

Conclusions

Teacher growth that may have been attributed to the Marin project was reflected in the classroom only to a small extent. The meager returns do not warrant confidence in curriculum projects of the type described as means of accelerating the professional growth of teachers in such ways as to effect improved instructional practices in the classroom.

Further research is suggested on the following questions: Would the experimental teachers have shown greater gains if a longer interval elapsed between the project and the classroom observations, thus allowing time to assimilate and integrate their new knowledge into action? Would a group of less "competent" teachers than those in the experimental group have shown greater gains than these because such a curriculum project would open professional vistas heretofore unrealized? Would greater gains have been made had the in-service function been paramount and skilled consultants in techniques of group processes have been in charge of the project?

Finding effective ways of changing behavior must influence new research. For changing curricula implies the changing of teacher attitudes, insights, and skills.

Microfilm \$2.95; Xerox \$10.35. 227 pages.

ART EXPERIENCES AND INTERESTS OF SELECTED GROUPS OF ADOLESCENTS

(L. C. Card No. Mic 59-6365)

Helen Louise Berking Northcutt, Ed.D. University of Missouri, 1959

Supervisor: Ralph K. Watkins

PURPOSE: To investigate the interests and activities of potential art value of boys and girls in the period of adolescence from twelve through seventeen years of age.

METHOD OF RESEARCH: The writer developed a questionnaire to gain information from adolescents about their art experiences and interests. Part I of the questionnaire included areas of interests and activities in which adolescents engage. Part II consisted of a check list of activities and of places where activities were done. The sampling was

made from all the students enrolled and present at the times the questionnaire was completed. The findings were tabulated and the data placed on cards which had been designed and prepared. Data cards were filed according to age, sex, and area of interest or activity. This method of tabulation and filing facilitated the study of any activity or interest by age, sex, or area of experience.

CONCLUSIONS:

- (1) An art program which is to meet and challenge the interests and needs of adolescents can start with their real-life experiences since consumer buying, opportunities for aesthetic enjoyment, hobbies in the home, school and club interests and activities have potential art value.
- (2) The differences in art experiences of boys and girls are influenced by the course offerings and content in the junior high school and senior high school years as well as by the interests and abilities of the individual students.
- (3) The adolescent's needs for more than one kind of social group in which to carry out his interests and activities are related to art experiences in which he may plan and participate: (1) as an independent individual, (2) in a large peer group, (3) in a more selected sub-group, and (4) with someone his own age and sex or someone his own age and opposite sex.
- (4) Vocational guidance for the adolescent should include acquaintance with a variety of vocations in art and knowledge of job opportunities as well as understandings of self-abilities and limitations.
- (5) The interests and activities of the adolescent have meaning for art education regarding the nature of the adolescent learner, the understanding of teaching methods, and the selection and organization of activities for a secondary school art program consistent with the desired goals of education for youth in a democratic society.

RECOMMENDATIONS:

- (1) The investigation disclosed the need for art educators to re-evaluate present curriculum offerings in art in the junior and senior high school years, and the media and equipment with which the students work in light of experiences which meet the interests and needs of the adolescents in general education and specifically for the gifted, the talented, or those with a persistent interest in creative experiences.
- (2) It would be desirable for the present investigation to be followed with a similar study of the areas of art experiences with experimental groups of junior and senior high school

- students to determine further evidence of the differences in art experiences and interests of boys and girls at various ages.
- (3) The study also emphasized the need to explore ways in which additional art interests or new approaches to previously discovered art interests may be fostered during the period of adolescence.

Microfilm \$2.85; Xerox \$9.90. 219 pages.

A COMPARATIVE STUDY OF THE LEGIBILITY
OF HANDWRITING OF 454 ADULTS TRAINED
IN THREE HANDWRITING STYLES: ALL
CURSIVE, ALL MANUSCRIPT, OR
MANUSCRIPT-CURSIVE.

(L. C. Card No. Mic 60-1113)

Elaine Mildred Templin, Ph.D. New York University, 1959

Since it is essential that handwriting remain highly legible under pressures of time and continued use, it seemed important that a study be made of the handwriting of adults trained in three handwriting instructional programs—manuscript, cursive, and manuscript—cursive—in order to determine whether or not adult handwriting is more legible as the result of a specific handwriting training.

The hypotheses tested as the basis for this study were: (1) that the legibility of adult handwriting may be affected significantly by the extent to which handwriting is used, by the sex of the writer, and by the occupation held by the writer; and (2) that manuscript writing in adult life is more legible than cursive handwriting.

The 1946 high school graduates from twenty communities located on the eastern seaboard provided the population included in this survey. Four hundred fifty-four graduates, twenty-three per cent of the located population, responded. Fifteen per cent were excluded, however, because they are left-handed, have changed the hand with which they write, have suffered a crippling disease or a disabling hand injury.

Homemakers, business workers, educators, and engineers accounted for nearly sixty-five per cent of the total response.

Seven survey instruments were used—a cover letter, participation card, discussion card with one follow—up, and a questionnaire with two follow—ups. The t test, applied to observed differences in mean legibility achieved by those using normal—sized writing on the card and those writing smaller than normal, indicated the use of a post card for discussion purposes had not affected significantly the handwriting legibility of respondents.

Since respondents were asked not to sign the discussion card or questionnaire, both instruments were coded in order to identify them with the respondent. However, anonymity was guaranteed. Graduates did not know, when completing their discussion cards, that they were participating in a handwriting study.

Freshmen students from New York University served as judges to determine the legibility of handwriting samples. They qualified by achieving a minimum of fifty per cent accuracy in rank-ordering specimens cut from the Ayres Handwriting Scale, Gettysburg Edition, and Conard Scale, Ink Forms. Furthermore, the three judges constituting

each jury were required to average seventy-five per cent accuracy on each Scale.

Each judge read one hundred discussion cards in the presence of the investigator. Fifty were read in each of two sittings.

After the cards had been read by all three judges, they were grouped according to percentage of illegibility, were ranked from best to worst, and were given scores ranging from one hundred to one by the jury assigned to rank-order them.

The calculation of X^2 on the distribution of illegibilities noted by the three judges on each jury, indicated a lack of bias in the reading of discussion cards submitted by respondents from the three handwriting populations.

Findings indicated that: (1) the pencil, ball-point pen, and fountain pen-in that order--are the most commonly

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used writing tools; (2) making out checks, social correspondence (primarily a female utilization of handwriting), filling in forms, preparing shopping lists, and signing or initialing forms or letters—in that order—are the most common uses of handwriting; (3) adults average nine pages of handwritten material weekly—an estimate based on a standard 8 1/2 x 11 sheet of paper. Females averaged more writing than males except for male professional and white collar workers, trained in an all-manuscript population.

The major factorial design was the analysis of variance. Although there was evidence that significant differences were present for two variables—type of writing and amount of writing—a significant second—order interaction prohibited a definite acceptance or rejection of the basic hypotheses.

Microfilm \$2.75; Xerox \$9.45. 210 pages.

ENGINEERING

ENGINEERING, CHEMICAL

A CORRELATION OF PULSE COLUMN LIQUID-LIQUID HEAT TRANSFER

(L. C. Card No. Mic 60-1291)

William Berdell Barlage, Jr., Ph.D. North Carolina State College, 1960

Supervisor: Dr. F. P. Pike

An extended study has been made of the rate of heat transfer between benzene and water in direct contact in a pulse column, and of the operating variables which controlled the behavior. In this mode of heat transfer the benzene was dispersed as a family of droplets in the water, which formed the continuous phase.

The equipment was insulated and modified in many details to permit precise heat transfer measurements. Several aspects of previous work were revised or reinterpreted, while one new factor was discovered, the existance of heat loss due to benzene evaporation during transit of the contactor. The final manner of operation and treatment of the data gave heat balances that consistently agreed with 10-percent.

Correlations were developed relating the variables, rate of pulsing, superficial velocity ratio, 1n-mean temperature difference, kinematic viscosity, and total flow rate to the heat transfer responses, over-all volumetric heat transfer coefficient, and height of over-all continuous and discontinuous phase heat transfer units for heat transfer from the continuous to discontinuous phases. Similar correlations were approximated for heat transfer from the dispersed benzene to water.

A study of temperature differences at the ends of the column, augmented by several temperature probes within the column, led to the conclusion that rather large endeffects existed. The temperature probings also settled a major point by proving that use of the 1n-mean temperature difference was valid over the contacting region of perforated plates themselves.

A limited series of runs showed conclusively that the reversal of the direction of heat transfer made a rather large difference in the results, indicating that internal circulation and natural convection within the drops were prominently involved in the heat transfer mechanisms. The presence of internal circulation and natural convection within the drops was further substantiated by the relation of kinematic viscosity of the discontinuous phase, indicative of temperature level, and the 1n-mean temperature difference as part of a Grashof number, applicable to natural convection.

Microfilm \$3.45; Xerox \$11.70. 268 pages.

A CONTINUOUS COUNTERCURRENT LIQUID-SOLID CONTACTOR. ITS DEVELOPMENT, CONSTRUCTION, AND PERFORMANCE.

(L. C. Card No. Mic 60-1288)

Eugene Edejus Erickson, Ph.D. North Carolina State College, 1957

Supervisor: Frederick Philips Pike

A new moving-bed liquid-solid contactor has been developed. Its utility lies in the fact that it might become a means of placing liquid-solid mass-transfer operations on a operational basis analogous to the more common continuous, countercurrent gas-liquid and liquid-liquid processes. A laboratory-scale, single-section contactor was built, and was operated successfully over a wide range of operating conditions. The equipment is mechanically simple, with a diaphragm pulsing pump as its only moving part. The pulse velocity is essentially sinusoidal. Part of the up-pulse serves to move the solids bed upward in the column, while the balance discharges the liquid phase from the bottom of the unit. Liquid is pumped down thru the solids bed by the down-pulse. The pulsed liquid flows thru a bed-supporting filter-screen at the base of the column. A solids-feed slurry, flowing very nearly as a packed bed, enters the column by gravity when the uppulse raises the bed. The solids bed moves in the column essentially as a plug, without mixing.

The performance of a 1.5-inch i.d. contactor was studied in regard to thruput capacities. Average and maximum liquid pressures in the column were measured. Most of the program concerned 20-50 mesh ion-exchange resins, but resins as fine as the 50-100 mesh range could be handled by gravity feed. A scheme was devised for handling finer solids, but further work is needed to obtain the degree of flow control required.

The resin thruput capacity is a response to the operating variables - the pulse frequency and amplitude, and the liquid flow rate; and to the column variables - the column geometry and feed conditions. The liquid pressures adjust themselves to their necessary values.

The responses were studied over most of the operating range of the equipment for the 20-50 mesh resin; frequencies from about 1 to 110 cycles per minute; amplitudes from 0.24 to 1.08 inches; and liquid flow rates up to 200 gal/(ft²)(hr). The optimum frequency ranged from about 5 to 15 CPM, varying with the amplitude and liquid flow rate. The optimum amplitude was about 0.5 inch at 50, and about 1 inch at 100 gal/(ft²)(hr) of liquid flow. Resin rates decreased as liquid rates increased, dropping to zero as the liquid rate approached the pulsing rate. For given column geometry and feed conditions, the resin rate was expressed graphically as a function of an effective pulse rate and the amplitude.

Increasing the column length from 10.5 to 28.5 inches

markedly decreased the resin rate. This effect requires further investigation before length scale-up can be attempted. The flow of solids through the feed tube was controlled by the liquid pressure driving-forces, and the friction of the solids bed against the tube wall.

Liquid flow thru the resin bed in the column and in the feed line was shown to follow the pattern of viscous flow, and could be predicted from fixed-bed measurements.

The types of contactors currently in use were discussed. The development program leading to the selection of the contactor design, and details of the equipment used, were described.

Microfilm \$3.70; Xerox \$13.05. 288 pages.

HEAT- AND MASS-TRANSFER TRANSIENTS IN CYLINDER DRYING.

(L. C. Card No. Mic 59-3877)

David Hansen, Ph.D. Rensselaer Polytechnic Institute, 1959

Supervisor: Alfred H. Nissan

An investigation has been made of transient heat transfer, and water removal on a cylinder dryer. The investigation included the development of a theory for describing conduction of heat in the drying material and an experimental testing of the adequacy of the theory.

The theory describes the heat transfer in terms of a second order partial differential equation and appropriate boundary conditions. The evaporation of water, or the drying, appears as an integral part of the boundary conditions. Numerical solutions for the equations, obtained on an IBM 650 digital computer, are presented.

The experimental work included the measurement of temperature-time relation at internal points in a drying sheet, and the measurement of moisture removal during the operation. This experimental work was performed on a single-cylinder experimental dryer constructed specifically for this purpose.

Good agreement between theory and experimental results was found, and the usefulness of this method of analysis was demonstrated by the determination of cylinder to sheet heat transfer coefficients, and the analysis of water removed in terms of components removed by different mechanisms.

Although the work was primarily concerned with description of paper drying, the theory and methods should apply equally well to the drying of other materials on heated cylinders. Microfilm \$2.50; Xerox \$4.60. 90 pages.

flow rate. The agricums amplitude was about 0.5 Inch at 50, and about 1 inch at 100 gat (if '3)ar) of liquid flow.

RADIATIVE AND CONDUCTIVE HEAT TRANSFER IN A QUIESCENT GAS-SOLID BED OF PARTICLES; THEORY AND EXPERIMENT.

(L. C. Card No. Mic 59-5187)

Frank B. Hill, Ph.D. Princeton University, 1959

This thesis concerns a study of radiation as a contributing mechanism in the transfer of heat between discrete solid particles. A theory for transfer in such systems is generalized to include planar, spherical, and cylindrical bed geometries; because of the particulate nature of the system the generalization is given in terms of finite difference equations. Transfer experiments were performed in a quiescent cylindrical bed with an axial heat source and a cylindrical containing-wall sink. Heat fluxes and radial temperature profiles were measured. The experiments were arranged such that only modest temperature gradients were established between source and sink, but the ambient sink temperature was taken in steps from 100° to 1000°C. Particulate aggregates find use in technology in such systems as catalytic chemical reactors, pebble heaters, thermal insulation, and solid fuel beds. They have been suggested for use in nuclear reactors.

The analysis considers radiant heat transfer in a bed of particles to be described by a difference equation network which has properties of absorption, reflection and transmission associated with node points. Hamaker's formulation, which was based on a differential equation and planar geometry, was thereby extended to include all three coordinate systems in finite difference expression. A relation between effective radiation characteristics of a bed and those of the particles themselves is presented.

Experiments were restricted to 3.8 mm diameter alumina spheres in air at atmospheric pressure, arranged in a bed 12 cm in diameter and 61 cm long. An axially placed Calrod heater served as a heat source. Heat flux was measured from the power input to the rod. Thermocouples were placed at radial stations among the particles. The assembly was placed vertically within a large furnace which provided various ambient temperatures.

It was found that temperature distributions within the bed were Fourier distributions as is to be expected with small gradients such as were imposed. There was departure from this relationship near both boundaries. In agreement with Pollack who found similar results, thermal conductivities at points within the bed were about 40 percent larger than over-all conductivities. One the assumptions of additivity of radiation and conduction and the absence of convection a correction was applied to the local conductivity to secure the contribution due to radiation alone. The ratio of heat transferred by radiation to that transferred by conduction was found to increase with average bed temperature from the order of 0.1 at 100°C to 1.2 at 1000°C.

The theoretical development when applied to the experimental radiation results in the bed proper permitted evaluation of a parameter, ρ - τ , which is the difference between the reflectivity and transmissivity of a layer of particles of thickness equal to the mean particle spacing. From the known variation of the reflectivity of the particle substance with temperature it may be anticipated that the difference parameter for the assembled bed should

increase with temperature, as it was found to do, although an exact comparison was not possible.

The departures of the temperature near boundaries from the Fourier distribution, which Hamaker's theory attributes to interaction of conduction and radiation, could not be shown to be consistent with this interpretation. They were consistent, however, with the assumptions that there was imperfect thermal contact of the bed with its container and that the temperature discontinuities resulted primarily from conduction across an air film there.

Microfilm \$2.50; Xerox \$7.20. 154 pages.

THE EFFECT OF VIBRATION ON FORCED CONVECTIVE HEAT TRANSFER

(L. C. Card No. Mic 59-6067)

Chung-kong Hwu, Ph.D. University of Cincinnati, 1959

An experimental investigation of the effect of vibration on forced convective heat transfer was made by using a horizontal double-pipe steam-to-air heat exchanger. Vibration was induced acoustically and superposed directly onto the air stream. The independent variables studied were flow rate of air, frequency and amplitude of vibration. The imposed vibration was found to have appreciable effect only when it was at such frequencies that standing waves with appreciable amplitude were set up in the heat exchanger tube. Under these favorable conditions, increase in h (the heat transfer coefficient) up to 50% in the viscous region and 27% in the turbulent region were observed.

The value of h was observed to increase with increasing amplitude of vibration, other variables constant. h also increased with decreasing wave length of the standing wave. For a given vibrational mode, improvement in h increased with flow rate up to Re = 2080 but decreased as flow rate further increased. Improvement in h was correlated in terms of Reynolds number, an amplitude parameter and a frequency parameter. The amplitude parameter is defined as the ratio of the gross root mean square pressure amplitude with vibration to that without. The frequency parameter is defined as the product of the resonant frequency and the total length of the heat exchanger tube divided by the velocity of sound. In the case of a Kundt's tube, used in the present work, the frequency parameter is n/2, where n is a positive integer. Two dimensionless equations were developed, based on the data. One covered a range of flow from Re = 828 to 1450 and the other from 2590 to 5920.

Microfilm \$2.50; Xerox \$7.60. 165 pages.

A STUDY OF DIELECTRIC PROPERTIES OF SIMPLE ALKALI SILICATE GLASSES AT LOW FREQUENCIES

(L. C. Card No. Mic 60-1442)

Wing Cheuk Lo, Ph.D. Rutgers University, 1960

Major Professor: Dr. Harold T. Smyth

The dielectric behavior of glass in the medium-to-low frequency range has often been attributed to the presence of relaxation mechanisms. In this range of frequency, the important relaxation process is generally believed to be the movement of alkali ions between equilibrium positions. Some study on this relaxation phenomenon of glass has been made at elevated temperatures. However, little has been done on the subject at ordinary temperatures since it will require measurements of the dielectric properties at very low frequencies.

In this investigation, a wave-form method which was developed for providing low-frequency data for the study of the relaxation spectrum of glass is described. In spite of its limitations, the data obtained by this method on nine simple alkali-silicate glasses of different compositions indicate the presence of the relaxation spectrum. For the single alkali-silicate glasses, the peak of tano at room temperature is in the range of frequency investigated (viz. 0.15 to 4 c.p.s.) while for the mixed alkali-silicate glasses containing theoretically the same mole% of R₂O, the peak is situated at much lower frequencies. Room temperature measurements of these glasses at audio and radio frequencies fit in with the low-frequency data satisfactorily.

The applicability of the low-frequency method for measuring d.c. conductivity of high loss glasses is also discussed. Microfilm \$2.50; Xerox \$6.00. 122 pages.

DESIGN, CONSTRUCTION AND OPERATION OF A MOVING BED CHARCOAL ADSORPTION COLUMN.

(L. C. Card No. Mic 60-869)

Fernando Oré, Ph.D. University of Washington, 1959

In the course of this work, a pilot scale moving bed charcoal adsorption column was designed, constructed, and used in the separation of light hydrocarbons gas mixtures.

In order to increase the efficiency of the column, the radial gas composition concentration gradients were reduced, and efficiency of the column improved by a special channel arrangement used in the adsorption section. In this section, the carbon flowed by gravity inside each of two one-inch thick vertical channels with perforated metal walls. A series of baffles forced the gas to zig zag upward across the vertical carbon layers. In the stripping and rectifying sections, the carbon flowed down as a distributed layer over the inclined upper surfaces of a series of plate units. This plate arrangement facilitated the stripping and rectifying operations.

Satisfactory results were obtained for separations of ethane-propane and ethylene-propane gas mixtures. The

results obtained for the separation of propane-butane gas mixtures, were not satisfactory at the operating conditions used in this work.

Microfilm \$2.50; Xerox \$8.20. 177 pages.

ENGINEERING, ELECTRICAL

STUDY OF SEMICONDUCTOR DEVICES BY ANALOGUE TECHNIQUES

(L. C. Card No. Mic 60-1352)

Ramasesha Bharat, Ph.D. Stanford University, 1960

In this thesis, analogue techniques are applied to the study of semiconductor devices in pulse circuits, enabling one to make a transient analysis of models which describe both the internal and the terminal behavior of the devices. Physical phenomena in semiconductor devices are described in terms of lumped models and an analogue computer is set up to simulate the equations derived from these models. Equations relating the variables in the model of the device to the variables describing the circuit in which the device is operating are also simulated on the computer, and transient solutions are obtained for all the variables.

The behavior of a semiconductor device in a pulse circuit is generally described by a set of nonlinear partial differential equations. Analytical methods of solution of these equations are not available except for a few special cases involving simple geometry and boundary conditions. If numerical methods were used, the problem of convergence of the solution would arise as the variables have to be quantized in both space and time. By using an analogue approach, in which time is treated on a continuous basis and the variables are quantized only in space, the problem of convergence is eliminated.

Analogue computer and electric circuits are very convenient analogues due to the ease of measurement and control of the variables and parameters in these systems. The electric circuit is useful when linear phenomena in semiconductor devices are to be simulated. For simulating devices in which several nonlinear phenomena are present, the analogue computer is more convenient, as problems associated with construction of special electric circuits are avoided.

Computer and electric-circuit analogues of several physical phenomena frequently encountered in semiconductor devices are developed in this thesis. Both linear and nonlinear phenomena are considered and various methods of simulating them are described. Analogue computer solutions are obtained for transistor pulse circuits in which interacting nonlinear phenomena influence the operation of the circuit. Solutions for a drift-transistor switching circuit and for an avalanche-transistor relaxation-oscillator circuit are presented.

Variations in the constructional characteristics of a semiconductor device, such as geometry and doping profiles and variations in the circuit parameters, affect the performance of the device in a circuit. The use of the

analogue computer provides a new technique for studying the effects of these variations. Correlations can be obtained between the constructional characteristics of a device and its terminal behavior. A drift-transistor pulse circuit, in which the device and circuit parameters vary, is simulated to illustrate the use of the analogue computer in obtaining these correlations. This technique is a convenient tool both for the development of a model for an existing device and for the design of new semiconductor devices intended for specific circuit applications.

Microfilm \$2.50; Xerox \$4.80. 92 pages.

THE DETERMINATION OF IONOSPHERIC ELECTRON CONTENT AND DISTRIBUTION FROM SATELLITE OBSERVATIONS

(L. C. Card No. Mic 60-1359)

Owen Kay Garriott, Ph.D. Stanford University, 1960

The transmissions from orbiting earth satellites provide a new technique for the study of the earth's ionosphere. The upper portion of the ionosphere has been previously inaccessible to radio investigation except through use of moon echoes. Satellite radio beacons now permit a convenient measure to be made of the electron content up to the satellite height. As the height of a satellite passage above a particular geographic latitude varies, due to the very slow rotation of the line of apsides, information relating to the average distribution of electrons is obtained.

The measurements of electron content are made in two ways: by observing the rate of polarization rotation due to the Faraday effect and, largely independently, by estimating the total number of polarization rotations at the time when the satellite is at its closest approach. A number of corrections to the simplified analysis must be included if useful values of electron content are to be obtained. If the satellite orbit is sufficiently eccentric, the satellite vertical-velocity component may provide an estimate of the local electron density.

The observations which have been analyzed are of the 20-Mc telemetry and 40-Mc second harmonic of the Soviet satellite $1958\,\delta_2$ (Sputnik III) in the period between Septemper, 1958 and April, 1959. The calculations reveal that the ratio of the total ionospheric-electron content to the content of the lower ionosphere below the height of maximum density is approximately 4:1, as found by Evans from moon echo measurements. An appreciable diurnal variation is noted, however, with this ratio tending toward 3:1 in midday and 5:1 at night.

As the height of the satellite at the Stanford latitude increased from less than 300 km to over 900 km, an 'average' electron density profile was determined. This profile indicates that the electron density has decreased to 50% and 20% of the maximum density at heights of 150 km and 400 km, respectively, above the height of the maximum electron density. Extreme distortions of the quiet-day profile were found on days of high magnetic activity. On a number of active days, the maximum electron densities were depressed to 30% to 50% of the normal, quiet-day values; yet the total ionospheric content was

near normal. This requires a very slow decrease in electron density above the height of maximum density.

Microfilm \$2.50; Xerox \$4.00. 73 pages.

A POTENTIAL METHOD FOR DETERMINING NET ION DENSITY IN AIR

(L. C. Card No. Mic 59-6275)

Seymour Blair Hammond, Ph.D. Purdue University, 1958

Major Professor: Stephen Freeman, Jr.

The Potential Method for determining the net space charge or net ion density in air requires (1) a means for measuring the electrostatic potential attributed to the ion space charge, and (2) the calculation of net space charge or ion density from the potential measurements and the boundary conditions of the ionized region. This dissertation discusses an electronic electrometer and the rotary electrostatic generator with radioactive probe for the potential-measuring problem, and the solution of Poisson's Equation relating electrostatic potential to space charge or net ion density by finite differences and by an electric circuit analog. A set of curves in the Appendix can be used to convert electrostatic potential to net ion density for a large number of geometric configurations of boundaries, from which other solutions can be extrapolated.

The electronic electrometer is manually operated and utilizes only conventional electron tubes and parts. It employs the null and substitution method, and takes only a minute or two to complete the measurement of electrostatic potential, once the probe is in place. The rotating electrostatic voltmeter continuously records the electrostatic potential at the position of the probe. It is comprised of an electrostatic generator, a d-c amplifier, and a recording milliammeter.

For the solution of Poisson's Equation, it is assumed that space charge density is constant in the region within grounded, rectangular boundaries. The method of finite differences is employed with the aid of a card-programmed calculator to find the solutions for several rectangular boundary configurations. The results are plotted as potential versus position-in-space in the space-charge region for several space charge densities. Since potential is directly proportional to space charge density, the space charge or ion density can easily be extrapolated between known values. From the several boundary configurations solved, it is possible to approximate solutions to most other boundary configurations. The curves and instructions are included in the Appendix.

Experimental comparison with ion collector measurements of ion density and the Potential Method described shows reasonable correlation between these two methods. The advantages of the potential method over the ion collector method indicate continued use and development of the Potential Method.

An electric circuit analog of the electrostatic field problem is developed. In this analog using equal resistances, the value of the resistance is proportional to distances and the space charge density is proportional to the current fed into the nodes between the resistances.

Constant current generators consisting of a high voltage source and a large series resistance are used. Thus, the electric circuit analog consists only of a single voltage source and a number of resistances. An electric circuit analog in two dimensions is used to confirm the solution of Poisson's Equation as obtained by the card-programmed calculator. The electric circuit analog for Poisson's Equation offers considerable promise for future solutions of similar equations.

Microfilm \$2.50; Xerox \$6.00. 122 pages.

ANALYTICAL TECHNIQUE FOR OPTIMIZING THE HALL EFFECT

(L. C. Card No. Mic 60-1365)

George Michael Krembs, Ph.D. Stanford University, 1960

The deflection of moving carriers in a metal or homogeneous semi-conductor located in a magnetic field was first discovered by Hall in 1879. Since that time it has become a standard tool for solid state research and has found many important device applications. However, except for experimental data associated with particular applications, there does not exist any thorough theoretical study of signal levels and noise in the Hall effect as a function of the material constants, the geometrical configuration, the ambient and the operating conditions. The purpose of this study is to develop an analytical technique for determining the optimum values of these parameters whenever the Hall effect application requires either a large Hall voltage per unit of magnetic field strength or a good signal-to-noise ratio; in general, these optimum values will differ for the two specifications and the selection of them will depend on the relative importance of maximizing the signal level or the signal-to-noise ratio.

The major results of this study can be summarized as follows:

- 1. From a thermal analysis of the signal level in a Hall device mounted on a simple heat-sink structure, it is shown that there exists an optimum crystal temperature at which the Hall voltage is a maximum.
- 2. Since no material exists with all the ideal properties desired for a Hall generator, the proper choice of available materials is found to depend strongly on the temperature of the environment. Furthermore, the relative importance of these material parameters varies over the range of heat-sink temperature; for example, a material with a low electron mobility ratio, but a large energy gap, could make a better Hall generator than a material with a desired high electron mobility and mobility ratio, but a small energy gap.
- 3. The power spectrum for the noise sources in the Hall device is demonstrated by means of a theoretical analysis of the Hall voltage as a function of the fluctuating charge density to be proportional to the spectrum for the current noise, where the value of this proportionality "constant" is determined as a function of the material parameters and other variables. Thus, the theory for the Hall noise spectrum could be obtained from the available literature on semiconductor current noise.
 - 4. The signal-to-noise ratio, formulated from the

investigations of the signal level and Hall noise spectrum, is shown to have an optimum temperature which differs from the maximum signal condition, and to approach a constant value with increasing magnetic field strength, provided the misalignment noise is negligible.

Because of the large number of variables involved in this analysis, most of the above results had to be illustrated in this report for special simplified examples, and qualitative arguments given to support any generalizations of the conclusions derived from the special cases. The complicated general expressions can be solved by a graphical procedure, and are calculated in this manner for the computations with parameters for available semiconductors.

Although the calculated signal level and its optimum crystal temperature agreed well with the experimental measurements on germanium and silicon, further experimental investigations of the signal level in intermetallic compounds and the signal-to-noise ratio are necessary in order to check the validity of that aspect of this design theory.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

THE STUDY OF POSSIBILITIES FOR IMPROVING SPACE UTILIZATION AND PERFORMANCE OF RHOMBIC ANTENNAS

(L. C. Card No. Mic 60-1368)

Angel M. Martin-Caloto, Ph.D. Stanford University, 1960

A study of the mutual coupling of concentric rhombic antennas is made together with the analysis of the radiation properties of multiple concentric rhombics.

Rhombic antennas can be concentrically located without appreciable mutual current effects. When simultaneously driven, and for the case of parallel concentric rhombics, the total radiation intensity function is given by

the total radiation intensity function is given by
$$K_{T}^{2} = |K_{1} + e^{j\delta_{2}}K_{2} + e^{j\delta_{3}}K_{3} + \dots + e^{j\delta_{n}}K_{n}|^{2}$$
(1)

where

$$K_n = 4I_{ne} \sin A \frac{\sin u_n}{\sqrt{u_n}} \frac{\sin \nu_n}{\sqrt{\nu_n}}$$
 (2)

and $e^{j\delta_n}$ represents the phase delay of current in Antenna n with respect to current in Antenna 1 for points in planes perpendicular to the main axis of the antennas. A is the acute angle of the antennas; I_{ne} is the effective current of Antenna n and u_n and ν_n are given by

$$u_n = \frac{\pi a_n}{\lambda} [1 - \sin \theta \cos (\phi + A)]$$

$$v_n = \frac{\pi a_n}{\lambda} [1 - \sin \theta \cos (\phi - A)]$$
(3)

where a_n represents the leg-length of Antenna n. Calling $p_n = I_{ne}/I_{ie}$, $q_n = u_n/u_1 = \nu_n/\nu_1$; and when $\delta_n = 0$ and the ground effect is included, (1) is transformed into

$$K_T^2 = 16 I_{ie}^2 a_1^2 \sin^2 A | \sin u_1 \sin \nu_1 \sin (\beta H_1 \cos \theta)$$

+ $\sum_{n=1}^{\infty} p_n \sin (q_n u_1) \sin (q_n \nu_1) \sin (\beta H_n \cos \theta) |^2$ (4)

where H_n is the height above ground of Antenna n.

By proper selection of p's, q's, and H's, the radiation pattern can be controlled. For free space, there is a direct relation between the p's and the Fourier series coefficients of the desired radiation intensity function in the u, v plane. A similar relation exists between the q's and the frequencies of the corresponding terms in the series expansion. For a finite number of elements, corresponding to a finite number of terms in the series, the values of p's and q's can be chosen with the aid of a high-speed computer, to optimize the function obtained to yield uniform side lobes. A further change of the acute angle of each antenna to locate its own main beam at the desired elevation will increase the over-all gain. With only two elements, the side lobes can be reduced to at least 15 db below the main beam, with an increase of 3 db in the main beam gain with respect to the corresponding single rhombic. For the case of radio links, when two rhombics are required for a 4:1 frequency range, the small antenna (high-frequency range) could be located inside the large one (low-frequency range) and fed simultaneously in the low-frequency range to improve side-lobe reduction. With a third, still smaller, antenna, the performance in the high-frequency range can be similarly improved. Microfilm \$2.50; Xerox \$6.00. 124 pages.

THE FIELDS PRODUCED BY AN ACCELERATED ELECTRIC DIPOLE AT RELATIVISTIC VELOCITIES

(L. C. Card No. Mic 60-1301)

Harold Mott, Ph.D. North Carolina State College, 1960

Supervisor: George Burnham Hoadley

Equations are derived giving the potentials and fields of an accelerated electric dipole moving at relativistic velocities. The dipole is considered the limit of the combination of two electric charges of equal magnitude but opposite sign as the magnitude of the charges becomes infinitely large and the distance between the charges becomes infinitesimally small in such a manner that the magnitude of the charges multiplied by the distance separating the charges is constant. In the general case the dipole moment, defined as the product of the charge magnitude and the vector distance between the two charges, is time-varying. The classical electrodynamic theory based on the Maxwell equations is used in the derivations.

Electric flux lines are shown for special cases of unaccelerated dipole motion and are seen to be flattened in the direction of motion.

The directional rate of radiation is determined and shown graphically for special cases of dipole motion. It is shown that dipole radiation from ions is important in some experiments.

Microfilm \$2.50; Xerox \$6.60. 136 pages.

THE TECHNICAL DEVELOPMENT OF STAGE LIGHTING APPARATUS IN THE UNITED STATES, 1900-1950.

(L. C. Card No. Mic 60-1373)

Joel Edward Rubin, Ph.D. Stanford University, 1960

The purpose of this study is to establish the real and substantial, new and useful technical developments in stage lighting fixtures and lighting control during the period from the end of the nineteenth century through the first half of the twentieth century. The primary sources utilized in the study include the actual equipment, catalog materials, United States Patents dealing with improvements in equipment, oral and written discussions with authorities involved, and contemporary writings which indicate the technological progress of stage lighting equipment in the period under discussion.

During the period from 1900 to 1950 fundamental progress was made in light sources, stage lighting fixtures and control systems, and the stage lighting practice itself. The over-all period may be divided into three phases. The first period extending from approximately 1900 to 1920, was an era which saw the disappearance of acetylene, natural gas and limelight light sources, and the more widespread use of the relatively new incandescent filament lamp. This period contained the first tentative experiments in spotlighting practice, the gradual evolution of resistance dimmer control systems, improvements in the design of striplights and floodlights, and redevelopment of equipment to meet newly established standards of safety.

The second phase, encompassing the years from approximately 1920 to 1935, saw the development of highly concentrated filament lamps with prefocused bases, of Fresnel lens and ellipsoidal reflector spotlights, reflectors of permanent finish and high reflectance, multiscene preset switching systems, multiscene preset dimming systems controlled from console keyboards, and reactance and auto-transformer dimmers. Stage lighting practice following 1920 was increasingly characterized by the use of spotlights. The period from 1920 to 1935 was probably the most technologically active in the entire history of stage lighting.

The last phase of the study, from approximately 1935 to 1950, was an era in which the technological progress of previous years was consolidated and equipment underwent constant design and modification in attempts to improve efficiency and flexibility. This period has been characterized by such phrases as "the spotlight era" and "painting with light." Stage lighting was used as the coordinating element of stage spectacle, serving not only the purposes of selective visibility, plasticity, and mood and compositional effects, but also serving to organize and relate the actor, scenic investiture and stage space.

In addition to a detailed analysis of technological progress, investigation has been made of such secondary issues and problems as the record of technological advance claimed by David Belasco and his adherents, the increasing use of incandescent frontlighting in the theatre, the importance of the development of "C" and bridge fixture mounting clamps, and a consideration of the plate style dimmer as a unique American contribution to lighting control. An attempt has also been made to establish

the history of the theatrical lighting industry, through study of the major manufacturing organizations and their leading personnel.

The principal contributory factors to technological development in stage lighting in the period from 1900 to 1950 are: first, the commercial availability of the proper light source; second, improvements in related technical fields such as illuminating and optical engineering; third, the rising influence of the illuminating engineer, the lighting consultant and the lighting designer; fourth, the codification of local and national fire and electric regulations; and fifth, the stimulation and incentive attendant upon extensive theatre building. Finally, the most persistent contributory factor to technological advancement was the development of the theory of the art of stage lighting. Lighting theory always preceded lighting practice in any given period; consequently the necessity of producing equipment capable of meeting the demands of lighting theory was a constant impetus to technological Microfilm \$4.35; Xerox \$15.30. 338 pages. progress.

FREQUENCY MEMORY UTILIZING RECIRCULATION

(L. C. Card No. Mic 60-1384)

Thomas Byrd Warren, Ph.D. Stanford University, 1954

General requirements of frequency memory are briefly outlined, and several recirculating type systems are proposed to meet these requirements. The recirculation system which is analyzed is one consisting of a wide-band amplifier and a long feedback delay line. This system is essentially a multi-mode oscillator effecting frequency memory by suitable mode locking.

The recirculation system in its linear form, is analyzed using the Laplace transform method. There is obtained a feedback equation whose poles yield the normal modes of the system. A simple division operation performed on this equation results in an expression useful in describing the behavior of the system for a small number of recirculations.

The non-linear behavior of the system is studied by assuming the amplifier to have the properties of a nonlinear resistance. The amplifier is then examined by analyzing the results of simultaneously applying a signal of large amplitude and one of small amplitude to the input of the amplifier. After reviewing the usual methods of non-linear analysis, it is found that a Fourier series expansion in two variables yields integral relations having physical interpretations. The results of these non-linear studies indicate that it is possible to construct practical non-linear amplifiers which provide discrimination against a small signal in the presence of a large signal. It is this discrimination which enables the system to be locked in many of the normal modes, even though the smallsignal loop gains of the various modes may differ considerably.

The stability of the recirculation system incorporating the non-linear amplifier is investigated by the method of equivalent linearization. In employing this method, it is assumed that frequencies of the normal modes are incommensurate, and that the system is quasi-linear. Conditions are formulated for stability for perturbations of either the oscillating or non-oscillating modes.

A further examination of the non-linear amplifier, where the possibility of commensurate normal mode frequencies is taken into account, reveals an important three-signal effect. It is found that if the input to the amplifier is of the form, $\delta \sin{(\omega_0-\omega_d)t}+A\sin{\omega_0t}-\delta \sin{(\omega_0+\omega_d)t},$ where δ is vanishingly small, then there is no small signal discrimination as in the two-signal case. It is shown that with the above three-signal input, the recirculation system can oscillate in a single mode only if the frequency of the mode occurs in the frequency region where the curve of loop gain vs frequency is convex upward.

The theory of the recirculation system is supported by experimental data taken on systems operating in various frequency ranges. An audio-frequency system using a tape recorder to provide delay, offers good confirmation of the mathematical analysis.

Microfilm \$2.50; Xerox \$6.00. 124 pages.

ENGINEERING, HYDRAULIC

EFFECT OF BOUNDARY FORM ON
FINE SAND TRANSPORT IN TWELVE-INCH PIPES.
[Abstract published in Dissertation Abstracts,
Volume XV, No. 12, pages 2499-2500.
Microfilm and enlargements available.]

(Publication Number 15,393)

Adrian Ramond Chamberlain, Ph.D. Colorado State University, 1955

Please find abstract on pages 2499-2500 in Dissertation Abstracts Vol. XV, No. 12, 1955. This dissertation has now been microfilmed.

Microfilm \$2.90; Xerox \$10.15. 224 pages. Mic 60-1733.

ENGINEERING, MECHANICAL

MEASUREMENTS OF FRICTION AND LOCAL HEAT TRANSFER FOR TURBULENT FLOW OF A VARIABLE PROPERTY FLUID (WATER) IN A UNIFORMLY HEATED TUBE

(L. C. Card No. Mic 60-907)

Redfield Wilmerton Allen, Ph.D. University of Minnesota, 1959

Experimental studies were made with water in turbulent flow in a circular tube using the extrapolation technique of Eagle and Ferguson to separate constant and variable property effects. Measurements were taken in the Reynolds number range 13,000 - 111,000 at a Prandtl number of 8. The uniform heat flux boundary condition was imposed on flow already hydrodynamically developed.

The apparatus was in the form of a closed piping loop. The loop contained a pump, a calming section 90 diameters long, a test section 30 diameters long, a flow metering orifice, and a cooler. The test and calming sections were made of 3/4 inch i.d. type 304 welded stainless steel tube. The test section was insulated from the piping system electrically and thermally and was heated by 0 - 1500 ampere alternating current which passed through the tube wall. Thermocouples were attached to the outer surface of the tube. Inner surface temperatures were calculated. Thermal conductivity and electrical resistivity of the tube were measured in the longitudinal direction using a coaxial tube set-up devised especially for that purpose. Results from the latter were within ± 0.5 percent of the straight lines,

7.94 (1 + 0.000774 t) Btu/ft hr ⁰F 27.18 (1 + 0.000677 t) microhm-inches

where t is in ⁰F.

A series of tests were run on the water loop apparatus at different heat inputs with Reynolds number and bulk temperature held constant at a point 22 diameters from the start of heating. At each Reynolds number local heat transfer coefficients fell within ± 1 percent of a straight line versus wall to fluid temperature difference. Extrapolation of the straight lines gave values corresponding to the constant property state of the fluid. Above a Reynolds number of 50,000 the values so found agreed to within + 0.5 percent with the recent constant property analytical work of Sparrow. As Reynolds number was lowered, experimental values fell slightly below the analytical curve due to transitional effects. The exponent on Reynolds number varied systematically from 0.84 to 0.87 for Reynolds numbers from 10,000 to 100,000 and the corresponding local heat transfer coefficients were 10 to 20 percent higher than predicted by the empirical equation of Dittus and Boelter.

The variation of local heat transfer coefficient due to changes in wall to fluid temperature difference decreased as Reynolds number was lowered below Re = 60,000. Above that value it tended to agree with the variation in $(\mu_{\rm bulk}/\mu_{\rm wall})^{0.14}$ taken from Sieder and Tate. The film temperature method overcorrected for property variation effects.

Test section friction factor decreased linearly as wall temperature increased at constant bulk Reynolds number. By using a Reynolds number based on wall temperature, a somewhat similar trend was predicted. The measured friction factor for unheated flow agreed with the equation of Prandtl and Kármán.

Thermal entrance tests were made at Pr = 7 and Re = 50,000. Heat transfer results, after extrapolation, agreed with the thermal entrance prediction of Sparrow beyond 10 diameters from the start of heating and were 1 to 2 percent below his curve upstream of this point. It is shown how the variable property effect in the axial direction can be approximately accounted for. A comparison is made with the work of Hartnett.

Microfilm \$3.60; Xerox \$12.60. 280 pages.

THE DENSITY OF CONCENTRATED NITRIC ACID

(L. C. Card No. Mic 59-6256)

Thomas Richard Bump, Ph.D. Purdue University, 1955

Major Professor: W. L. Sibbitt

The density of concentrated nitric acid was measured in the -30 to 100° F temperature range as follows: A measured mass of the acid was sealed in a bulb-shaped Pyrex container to which a Pyrex stem had been attached. The container was volume calibrated at different positions along its stem, so that the volume of the acid at any temperature could be determined by measuring the height of the acid in the stem with a cathetometer. The density of the acid at any temperature was then equal to its mass divided by its volume.

In the 100 to 300° F temperature range, acid densities were measured as follows: A measured mass of the acid was sealed in a volume calibrated section of thick-walled Pyrex capillary tubing. At any temperature both the liquid and vapor phase volumes of the acid were determined by measuring the height of the acid in the tubing with a cathetometer. This procedure was followed with two acid samples of different masses; both the liquid and vapor densities could then be found by solving two simultaneous equations.

The following equation was derived to correlate density values from the literature and was found to agree with the experimental values obtained:

 $m_L = 1.5813$

- 0.001020T $[0.482 108(W_{H_2O} 0.025)^2]W_{H_2O}$
- + $[0.310 + 0.00133T + (0.341 0.00444T)W_{NO_2}]W_{NO_2}$

where m_L is liquid phase density in gm/cc, T is temperature in ^{0}F , W_{H_2O} is weight fraction of water and W_{NO_2} is weight fraction of NO₂ present in the acid. This equation apparently may be used to 100^{0} F with an accuracy of $\pm 0.5\%$ and to 300^{0} F with an accuracy of $\pm 1\%$, regardless of extent of acid decomposition, providing the acid originally has no more than 5% water and 5% NO₂ present by weight.

The accuracy of nitric acid densities is definitely limited by the accuracy of the chemical analysis of the acid; with one standard analysis procedure it is doubtful if densities may be reported closer than $\pm 0.2\%$.

Microfilm \$2.50; Xerox \$6.60. 139 pages.

LAMINAR AND TURBULENT CONVECTIVE HEAT TRANSFER UNDER NONSTEADY THERMAL CONDITIONS

(L. C. Card No. Mic 60-1327)

Robert Donald Cess, Ph.D. University of Pittsburgh, 1959

An analytical study is presented for forced convective heat transfer in the thermal entrance region of a duct under prescribed nonsteady thermal conditions at the wall. The analysis deals specifically with circular tube and parallel plate geometries for which either the wall temperature or wall heat flux is a prescribed function of time.

By neglecting axial conduction (as well as axial heat transport by eddy diffusion for turbulent flow), general solutions are presented which may be applied either to laminar or turbulent flow. These solutions are first obtained for the case in which the entire system is initially isothermal, whereupon either the wall temperature is suddenly changed to and maintained at a constant value, or a constant wall heat flux is suddenly applied. The results are then extended to include arbitrary time variations of either wall temperature or wall heat flux as well as nonisothermal initial conditions.

The general solutions are applied to laminar flow for both the circular tube and parallel plate geometries, and to turbulent flow for the circular tube geometry. As a consequence of the assumed eddy diffusivity expression which was employed, the turbulent flow solutions are applicable only for a Prandtl number of one. However, because of the relative flatness of the turbulent velocity profile, an approximate method of solution for turbulent flow is obtained which applies for all values of Prandtl number. This approximate method requires knowledge only of the steady-state convection process.

Several examples are presented which illustrate the effects of time-dependent wall conditions. These include a linear increase of either wall temperature or wall heat flux with time, a "ramp" variation of wall temperature, an exponential variation of wall temperature, and a periodic wall temperature variation.

Microfilm \$2.80; Xerox \$9.70. 215 pages.

ENGINEERING MECHANICS

TURBULENT BOUNDARY LAYER OVER HEATED AND UNHEATED, PLANE, ROUGH SURFACES.

(L. C. Card No. Mic 59-5252)

Benoyendra Chanda, Ph.D. Colorado State University, 1958

Turbulent boundary layers over plane, rough, heated and unheated surfaces were investigated. Crushed stone of sizes between 0.25 in. and 0.315 in. glued to open-mesh fiber-glass cloth and laid on the floor of the wind tunnel formed the rough surface. Two air speeds, $U_o=17$ fps and 35 fps and one temperature difference for each velocity were used. The temperature differences were approximately 75° F and 48° F for $U_o=17$ fps and 35 fps respectively. The heated surface was 10 ft long beginning 43 in. downstream from the leading edge of the rough surface. Constant-temperature type hot-wire anemometers and a resistance thermometer were used to obtain the experimental data.

Considering density as a function of temperature, the displacement thickness δ^* , momentum thickness δ^{**} for the momentum boundary layer and the convective thickness

 $\delta_{\rm T}^{**}$ for the thermal boundary layer were used in forms similar to those used in the case of compressible fluids. The kinematic viscosity of air corresponding to the wall temperature ($T_{\rm W}$) rather than free-stream temperature ($T_{\rm O}$) was used as a reference viscosity.

Using an analysis similar to that presented by Townsend, Clauser, and Hama it is found that the velocitydefect law is universal for smooth, rough, heated and unheated surfaces. The logarithmic velocity-distribution curve (the wall law) is shifted by an amount $\Delta \overline{U}/U_{\star}$ depending on the magnitude of the roughness effect. The skin-friction law obtained from the wall law for a rough surface and the velocity-defect law, agrees with the experimental data for heated and unheated surfaces. Townsend's equation for the distribution of shear stress in the boundary layer over a smooth surface derived from the hypothesis of self-preserving motion and a constant eddy viscosity represents fairly well the distribution of shear stress in the outer part of the boundary layer for the unheated surface. The eddy viscosity in the boundary layer (y>4K_r) over a rough unheated surface is found to be constant and proportional to the product of free-stream density and velocity, and displacement thickness. The constant of proportionality is approximately equal to 0.018 as given by Clauser.

Applying an analysis similar to that used for the distribution of the velocity and the law of skin-friction and introducing the concept of friction temperature, the wall law and temperature defect law are obtained. The wall law for temperature distribution in the thermal boundary layer over a heated rough surface can be expressed by

$$\frac{T_{W}-\overline{T}}{T_{*}} = A_{1} \log \frac{yu_{*}}{\nu_{W}} + B_{1} - \frac{\Delta(T_{W}-\overline{T})}{T_{*}}$$

where \overline{T} is the temperature at any point in the thermal layer, T_* is the friction temperature defined by $q_w/\rho_0 gc_p U_*$. The quantity $\Delta(T_w - \overline{T})/T_*$ has the same significance for the temperature distribution as that of $\Delta \overline{U}/U_*$ for the velocity distribution. The temperature-defect law can be expressed by

$$\frac{\overline{T} - T_0}{T_*} = A_1 \log \frac{y}{\delta_T} + C_1$$

where δ_T is the thickness of the thermal boundary layer. The value of the constants A_1 , B_1 and C_1 are 6.6, 1.0 and 0.3 respectively. The logarithmic temperature-defect law represents the major portion of the temperature distribution in the outer thermal boundary layer. From the above equations, the local coefficient of heat transfer is obtained in the following form

$$\frac{1}{S_{t}} \sqrt{\frac{c_{f}}{2}} = A_{1} \log \frac{\delta_{T} u_{*}}{\nu_{w}} + (B_{1} - C_{1}) - \Delta \frac{(T_{w} - \overline{T})}{T_{*}}$$

where S_t is the local Stanton number and c_f is the local coefficient of skin-friction.

Vertical distributions of the intensity of velocity fluctuations as well as the intensity of temperature fluctuations are also presented.

Microfilm \$2.50; Xerox \$7.20. 153 pages.

THERMAL STRESS DUE TO DISTURBANCE OF UNIFORM HEAT FLOW BY CAVITIES AND INCLUSIONS

(L. C. Card No. Mic 60-1357)

Alexander Leonard Florence, Ph.D. Stanford University, 1960

When a body of linearly elastic isotropic homogeneous material is under a uniform temperature gradient no thermal stresses are produced provided the body is free to deform. Thermal stresses arise, however, if the heat flow is disturbed by an inclusion of another material or a cavity. No previous investigation of such problems has been found.

Several two-dimensional and axi-symmetric problems of this type are solved in this dissertation. The axi-symmetric cases are insulated prolate and oblate spheroidal cavities as well as the spherical inclusion. The plane-stress (or plane-strain) cases are circular and elliptic inclusions and the insulated ovaloid hole.

The axi-symmetric problems are solved with the aid of a displacement potential to provide a particular solution to the basic equations of thermo-elasticity. Appropriate complementary solutions of the basic equations are obtained by using the Papkovitch-Boussinesq representation. These are in fact solutions of isothermal boundary load problems. The boundary conditions lead to an infinite system of algebraic equations for the unknowns in the complementary solution. Numerical examples are given showing the stress distribution around a few shapes of insulated prolate and oblate cavities including the special case of the spherical cavity.

The plane-stress problems are first reduced by a general theorem to dislocation problems. These are solved by an adaptation of the methods of Muskhelishvili, requiring conformal mapping of the regions of the inclusions into the unit circle.

For the circular and spherical inclusions as well as the insulated elliptic and ovaloid holes, simple closed form solutions have been found. Any one of the stress components around an insulated cavity or hole (plane strain) is of the form

$$k G \frac{1+\nu}{1-\nu} \alpha \tau a$$

where G, ν , α , τ and a are respectively the shear modulus, Poisson's ratio, coefficient of thermal expansion, undisturbed temperature gradient and the semi-major axis of the generating ellipse of the cavity or ellipse of cross section of the hole. For the circular hole and spherical cavity a is the radius. k is a numerical coefficient depending on the coordinates of the point and the shape of the cavity or hole. k for the spheroidal cavities also depends on v. For the circular hole and spherical cavity the largest values of k are ± 2.0 and ± 1.0 respectively. If 2τa = 100°F (the temperature drop in the undisturbed heat flow in a distance equal to the diameter), the largest stresses are 6,400 p.s.i. for the circular hole (plane strain) and 3,200 p.s.i. for the spherical cavity. These are circumferential normal stresses at the poles on the axis of symmetry of the heat flow, compressive at the hot pole, tensile at the cool pole.

Near the regions of high curvature of the elliptic holes and oblate spheroids stress concentration occurs and grows without bounds as the curvature increases.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

BUCKLING OF A THIN CIRCULAR CYLINDRICAL SHELL HEATED ALONG AN AXIAL STRIP

(L. C. Card No. Mic 60-1364)

David William Hill, Ph.D. Stanford University, 1960

The problem considered is that of a thin circular cylindrical shell heated along a narrow strip in the axial direction. The restraint of the cooler portion causes compressive axial stresses in the heated strip, and if these stresses are sufficient in magnitude the cylinder can buckle into waves along the heated strip. The stability problem is solved using the Ritz method, assuming for the displacements Fourier series modified by a shape factor chosen to magnify the solution in the vicinity of the heated strip. The convergence rate of the solution is greatly increased by the shape factor. The cylinder is assumed to be simply supported on its ends so that the radial and circumferential displacements there are zero, but the axial displacements and end rotations are not restricted. The thermal stresses prevailing in the cylinder before buckling occurs are assumed to vary around the circumference but to be constant in the axial direction. Expressions are given relating the physical parameters of the cylinder, the temperature distribution, and the magnitude of the temperature causing buckling.

Experimental results are also presented for buckling tests on eleven cylinders. The experimental results were in reasonable agreement with the theoretical calculations.

The modified Fourier series assumed for the displacements are shown to converge to the true solution as the number of terms included becomes indefinitely large. For practical purposes the convergence is so rapid that a single term gives results correct to within a few percent.

Courant's maximum-minimum principle is used to establish that the buckling stress for a cylinder under uniform axial compression is a lower bound for all other cases of axial loading, provided that the buckling stress is taken as the maximum compressive stress on the cross section.

Microfilm \$2.50; Xerox \$5.00. 100 pages.

TEMPERATURE STRESSES IN SHELLS

(L. C. Card No. Mic 60-1376)

Gordon Edward Strickland, Jr., Ph.D. Stanford University, 1960

In this work a set of basic shell equations is derived which includes a description of the effect on the shell of temperature changes, but which is otherwise similar to a set of well known equations. There are no restrictive assumptions with respect to the geometry of the shell or on the symmetry of the temperature distribution. It is assumed that the shell thickness is everywhere small compared to the radii of curvature and that the displacement of the shell is everywhere small compared to the shell thickness. Hence, the equations obtained are linear.

With the basic equations at hand, consideration is then given to shell shapes which allow the basic equations to be simplified, combined, and solved. In particular, the

following are treated: (1) shells of zero Gaussian (total) curvature, including conical and cylindrical shells; (2) shells of constant Gaussian curvature, including spheres and certain other shapes; and (3) shells of more general form. For the first two of these categories, solutions are described (1) for arbitrary temperature distributions and (2) for temperature distributions arising from an idealized law of heat conduction and radiation derived in an appendix. For the shells of general shape, an iterative solution is described for arbitrary temperature distributions. The basis of this iterative solution is the usual membrane theory of shells.

A noteworthy innovation is the use of a stress function in treating all shells of constant and zero Gaussian curvature, a procedure which allows problems for such shells to be stated in terms of two equations in two unknowns.

The basic equations are formulated in terms of tensor calculus in order that they may be applicable to a shell of arbitrary shape. However, in subsequent chapters the final equations and the solutions are usually given in more usual notation. Microfilm \$2.50; Xerox \$4.60. 90 pages.

ENGINEERING, NUCLEAR

ANALYSIS OF BURNUP IN FIXED FUEL NUCLEAR REACTORS

(L. C. Card No. Mic 60-1290)

Syed Ahmed Hasnain, Ph.D. North Carolina State College, 1959

Supervisor: Raymond Leroy Murray

Methods are presented for predicting the effects of long operation on the properties of fixed fuel nuclear reactors. In the fundamental approach, the bare-equivalent model is employed with the flux assumed to be separable into space and time, $\Phi(r,t) = \phi(r) c(t)$, the amplitude c(t) varying to satisfy the constant power condition. The reactivity is maintained by means of a uniformly adjustable control poison \sum_{0} , whose change is governed by first order perturbation theory. Expressions for average concentrations of fuel isotopes, isotopic contributions to power and energy, flux amplitude, time of operation and reactivity are obtained in terms of the burnup functions, $B_{\ell}(x) = \frac{1}{V} \int \phi^{\ell}(r) e^{-\phi(r)x} dV$. These functions may be evaluated by series methods using tabulated flux averages over the core. For small x, $B_{\ell}(x) \simeq \overline{\phi^{\ell}} e^{-\phi} e^{\ell x}$, and the average flux treatment holds with effective fluxes $\phi_{ef} = \frac{1}{\phi^{\ell+1}} / \frac{1}{\phi^{\ell}}$.

The change in flux space dependence is studied by employing a single harmonic term to represent the change. Its effect is shown to be practically negligible.

The limitations of the bare-equivalent model and the Be method are examined by using the two-group fluxes for a reflected reactor. A first order correction for the

reflector consists of using $B_{\ell}(x) - xbR_{\ell}(x)$ instead of $B_{\ell}(x)$, where b is the coefficient in the thermal flux $\phi(r)=X(r)+bY(r)$ and $R_{\ell}(x)=\frac{1}{V}\int X^{\ell}Ye^{-Xx}dV$. For

reactors with very large reflector savings a more complicated BR treatment is suggested. A numerical analysis for an actual power reactor is presented. The results agree with those obtained by other workers using computer methods.

Microfilm \$2.50; Xerox \$6.60. 139 pages.

FINE ARTS

LOW-INCOME RURAL FAMILIES
IN AN URBANIZING SOCIETY

(L. C. Card No. Mic 60-605)

Murlin Ray Hodgell, Ph.D. Cornell University, 1959

An agricultural revolution is under way in America. Advances in agricultural technology are causing farming to evolve away from its traditional form as a "way of life", through a commercial type of operation, and toward an agro-industrial concept. These changes call for new qualifications for those who remain in agriculture, and they create severe new problems for those who cannot meet the new qualifications.

The rural people who find themselves caught in a centrifugal force at the edges of this vast movement are the special concern of this study. Four segments of the population are given particular consideration: the low-income subsistence farmer, the stranded farmer who has been forced off the farm in the consolidation process and who may be found at every economic level, the migratory worker, and the rural non-farm worker who, like his counter part in agriculture, has seen his job vanish with changing markets or depleted resources.

The root-causes of the plight of such people are inves-

tigated and the interrelationships between these elements of rural society and between their problems and the larger problems of agricultural and urban development are discussed. The strengths and weaknesses of past and present programs--ranging from the Rural Resettlement and Subsistence Homesteads Programs of 1934 to the Rural Development Projects of the present National Administration--which have, in whole or in part, aimed at the alleviation of difficulties such as these people face, are analyzed. New factors are introduced which would seem to be essential to any ultimate solution. Special attention is given to such urban problems as the rapid growth of slums, housing for minority groups, functional illiteracy, suburban sprawl, employment and industrialization, all of which have been greatly complicated by the farm-to-city migration.

Rural industrialization for small cities and rural communities is suggested as one key to solving many of the seemingly diverse problems which plague both rural and urban areas and which, at last, are shown to be but segments of one interrelated national problem requiring coordinated planning and action. While the study makes no pretense of solving this vast over-all problem, it does suggest directions which might be taken toward such a solution, and it does deal extensively with techniques of rural redevelopment and industrialization which, according to the author, must have a vital role in such a solution.

Microfilm \$5.70; Xerox \$20.30. 446 pages.

FOOD TECHNOLOGY

A STUDY OF THE STABILITY OF THE COLOR OF HIGH TEMPERATURE SHORT TIME STERILIZED GREEN PEAS DURING PROCESSING AND STORAGE

(L. C. Card No. Mic 60-1429)

Arnold I. Epstein, Ph.D. Rutgers University, 1960

Major Professor: Dr. C. Olin Ball

The equipment and procedure for pilot scale production of HTST sterilized peas is described.

Using this procedure the stability of the green color of peas was studied during processing and subsequent storage.

The loss of green color during processing was found to be first-order in relation to the processing temperature. The loss of green color during processing was found to decrease as the processing temperature was raised and the processing time necessary to produce commercial sterility at that temperature was reduced.

HTST sterilized peas were stored at controlled storage temperatures, 85° F., 50° F., 35° F., and -25° F. The loss of green color during the storage of HTST processed peas was found to be first-order in relation to the storage temperature.

The rate of loss of green color during storage was not found to be influenced by the degree of previous heat treatments during processing. The green color was lost at the same rate during storage after the peas were given equivalent processes at 265° F., 285° F. and 300° F.

The results of this study suggested that the natural green color maintained by the HTST process may be maintained for a few weeks by moderate refrigerated storage but that long term maintenance of this color would require frozen storage of the HTST sterilized peas.

Microfilm \$2.50; Xerox \$4.00. 71 pages.

GEOGRAPHY

THE GROWTH OF THE MARKET-ORIENTED ECONOMY IN NORTHERN RHODESIA, 1945-1955.

(L. C. Card No. Mic 59-6295)

Mahlon Carl Brown, D.S.S. Syracuse University, 1959

Please see abstract on Page 4299.
Microfilm \$3.60; Xerox \$12.20. 280 pages.

AGRICULTURAL LAND UTILIZATION IN THE LLANO ESTACADO OF EASTERN NEW MEXICO AND WESTERN TEXAS

(L. C. Card No. Mic 60-1536)

James Elmer Rowan, Ph.D. The University of Nebraska, 1960

Advisers: Leslie Hewes and Robert G. Bowman

That portion of the Llano Estacado of Eastern New Mexico and Western Texas, which centers around the City of Portales, New Mexico, and extends outward from that city some fifty miles in all directions is a transitional meeting place of several different kinds of agricultural land-use economies. These economies have evolved and arrived at their present form since the area began to be utilized agriculturally about 1885. Before 1885, the area was almost entirely in its natural state. The various agricultural economies which have been present or are still present in the area include: seasonal and year-round grazing of beef cattle; dryland farming of wheat and grain sorghums combined with grazing; dryland production of cotton combined with the production of sorghums and beef cattle; dryland production of sorghums as a cash grain crop, production of sorghums, cotton, and vegetables, under irrigation, combined with fattening of beef cattle in lots and grazing of beef cattle on dryland pastures; and production of peanuts, cotton, grains, alfalfa, sweet potatoes, and other specialty crops under irrigation, combined with dairving.

The major concern of this dissertation has been the ascertainment and delineation of present (1958) land-utilization areas in this portion of the Llano Estacado, as well as the determination of the land-utilization methods and practices used in the several areas.

Many physical and cultural factors have had an influence on the present land-use patterns and methods of production employed. Surface configuration in the area is generally level. Drainage away from the area is almost non-existent. The area has a semi-arid climate, and the possibility of heavy drouth is ever present. Several extremely sandy areas exist which are subject to dune formation when affected by drouth and seasonal high winds. These areas can reasonably be used only for moderate grazing. Many different soil series exist in the area. The variety of soils influences agriculturalists greatly when they finally determine how their land is to be used. The presence of several underground water aquifers has enabled farmers in some parts of the region to pump irrigate thousands of acres. Irrigation has greatly increased in importance since 1950 in three counties in the study area, and has maintained its importance in an older more mature irrigated area.

The western Llano Estacado was first utilized by ranchers, then homesteaders and persons who purchased land in small sized units entered the picture. More than half of the original settlers came to the area from eastern Texas; the remainder came largely from states northeast of the area. Soon after their arrival the settlers began experimenting with various crops and production methods in order to determine the most effective use of the land. This experimentive process still continues. Some of the crops which the early settlers introduced have emerged as basic crops in portions of several of the present landuse areas in the region.

There are presently seven different land-utilization areas in the region studied. Each of the seven areas has different concentrations of cultivated crops or other uses, and in each area agriculturalists employ distinctive farming or ranching methods. This variety of concentration has been illustrated by a land-utilization map of the region.

Microfilm \$3.90; Xerox \$13.75. 303 pages.

CRETACEOUS-TERTIARY PALYNOLOGY OF THE EASTERN SIDE OF THE SAN JUAN BASIN, NEW MEXICO.

(L. C. Card No. Mic 60-1350)

Roger Yates Anderson, Ph.D. Stanford University, 1960

Early studies of vertebrate and plant fossils in the San Juan Basin confirmed a late Cretaceous age for the Kirtland shale and a Tertiary age for the Nacimiento formation, but resulted in disagreement over the age of the intervening Ojo Alamo sandstone. Dinosaur evidence indicated a late, but not latest, Cretaceous (Montanan) age, but fragmentary plant megafossils suggested a Tertiary age. Pollen and spore florules collected from within, above, and below the formation tend to confirm a Tertiary age and reflect the environmental changes that accompanied local uplift at the Cretaceous-Tertiany transition.

The most significant ecologic change takes place at the base of the Ojo Alamo sandstone with the appearance of many podocarpaceous and ulmaceous pollen. The most significant change in terms of common forms occurs between the basal Ojo Alamo florule and one collected from a shale unit in the middle of the formation. The basal florule has only three forms in common with the overlying or underlying florules and could be either Cretaceous or Paleocene. The middle florule, however, has nine forms in common with the overlying Nacimiento florules, suggesting Tertiary affinity. Middle Montanan dinosaur bones and fragments, which occur in a similar shale unit on the western side of the basin, may be reworked or erroneously identified.

A Kirtland shale florule contains about equal proportions of dicotyledonous and monosulcate pollen and monolete and trilete spores. Proteaceous grains and Tilia are the dominant dicotyledonous types. Conifers are absent.

The florule from the base of the Ojo Alamo sandstone contains more than 70 percent Podocarpus pollen, ulmaceous pollen, and several other upland, inland, or more xeric pollen types.

The florule from the middle of the Ojo Alamo sandstone contains a mixture of probable upland and lowland forms as does a florule from the base of the Nacimiento formation. A florule in the lower part of the Nacimiento formation is similar to the florule at the base. Ulmaceous pollen, Momipites, and Cupanieidites are the most persistent dicotyledonous types in these three florules.

A florule from the uppermost part of the Lewis shale is a northern equivalent of one of the other florules but is very dissimilar because of a more coastal environment.

The classification system used in the study employs a combination of extant, organ, and form genera arranged in a phylogenetic outline. Eight new genera, Bombacacipites, Brevicolporites, Confertisulcites, Intertriletes, Kirtzipites, Navisulcites, Rectosulcites, and Ulmoideipites, are established, and several others are validated. Of the 88 fossil descriptions, 35 are new species and 4 are de-

scriptions of dinoflagellates and incertae sedis marine microfossils from the Lewis shale.

Microfilm \$2.50; Xerox \$7.80. 167 pages.

THE GEOLOGY OF THE JEWEL CAVE SW QUADRANGLE, SOUTH DAKOTA AND ITS BEARING ON THE ORIGIN OF THE URANIUM DEPOSITS IN THE SOUTHERN BLACK HILLS.

(L. C. Card No. Mic 59-5160)

William A. Braddock, Ph.D. Princeton University, 1959

Part I of this thesis covers the geology of the Jewel Cave SW quadrangle. In Part II the uranium-vanadium deposits of the southern Black Hills are described, and an hypothesis for the origin of the deposits is presented.

The Pennsylvanian and Permian Minnelusa sandstone consists of grey sandstone, very fine-grained dolomite, and anhydrite. The anhydrite has been leached from the formation near the outcrop. In the leached zone the rocks have been oxidized, and are red in contrast to their grey color in the subsurface. The anhydrite cement of the sandstones has been replaced by calcite, and the dolomite beds have been partly converted to limestone. Collapse as a result of the leaching produced breccias in the Minnelusa, and breccia pipes which extend upward at least as high as the Lakota formation.

The Permian Opeche formation consists of 75 to 115 ft. of red siltstones and shale with two thin gypsum beds. The Permian Minnekahta limestone is about 40 ft. thick. The Permo-Triassic Spearfish formation is about 550 ft. thick, and consists of red siltstone, red sandstone, dolomite, and gypsum.

The Upper Jurassic Sundance formation is divided into five sandstone and shale members which are 360 ft. thick. The Upper Jurassic Morrison formation consists of about 90 ft. of blocky weathering mudstone, minor limestone, and sandstone.

The Lower Cretaceous Inyan Kara group has been subdivided into the Lakota formation and the Fall River formation. The Lakota formation consists of 200 to 300 ft. of carbonaceous siltstone, blocky weathering mudstone, and fine-grained to conglomeratic sandstone. These rocks were deposited in stream channels, flood plains, and ponds. The Fall River formation is about 120 ft. thick. Along the northeast side of the outcrop the formation consists of sandstone which forms a body over $1\frac{1}{4}$ miles wide and over 25 miles long. To the southwest the formation consists of thinly stratified, interbedded sandstones, carbonaceous siltstones, and varicolored mudstones.

The uranium-vanadium deposits of the Edgemont district are restricted to the Inyan Kara group, and are most common near the base of the Lakota formation and in the lower part of the Fall River formation. The primary ore

deposits probably consisted of uraninite, low valence vanadium minerals, pyrite, and, locally, calcite. Most of the deposits have been extensively oxidized. The principal factor causing precipitation of the ore appears to have been the reducing action of fossil plant material in the sandstone.

Uranium may have been derived from the anhydrite beds of the Minnelusa formation at the time these beds were leached. The uranium-bearing solutions could have moved upward into the Inyan Kara rocks along permeable breccia pipes or along faults.

Microfilm \$3.30; Xerox \$11.20. 255 pages.

GEOLOGY OF THE IZEE AREA, GRANT COUNTY, OREGON.

(L. C. Card No. Mic 60-1382)

William Richard Dickinson, Ph.D. Stanford University, 1958

Approximately 135 square miles of dissected uplands in the vicinity of Izee on the South Fork of John Day River were included in the present study. Approximately 32,500 feet of strata, dominantly Mesozoic, are exposed within this area. The rocks include pre-Upper Triassic greenstone intruded by serpentine, Upper Triassic and Jurassic marine strata, and late Cenozoic continental beds. Thick sequences of volcanic sandstones (epiclastic) and tuffs (pyroclastic) are present at several horizons in the Mesozoic marine sequence. A geologic map at 1:24,000 scale was prepared during seven months of field work and approximately 250 thin sections were examined.

The purpose of the study was fourfold: (1) to describe the stratigraphic sequence; (2) to establish the age relationships and lateral facies relationships of the lithologic units; (3) to determine the genesis of a suite of unmetamorphosed albitic volcanic rocks, chiefly tuffs and volcanic sandstones; and (4) to determine the geometry of complex folds in Mesozoic strata which were formed during several orogenic pulses with different structural trends.

The Mesozoic sequence includes: three new Upper Triassic formations (nearly 15,000 feet), the Begg, Brisbois, and Rail Cabin, which are overlain conformably by a thin Hettangian unit, the Graylock formation (new); four upper Lower Jurassic formations (1500 feet), the Robertson, Suplee, Nicely, and Hyde; four Middle Jurassic formations, the Snowshoe (3500 feet) and three lateral time equivalents of portions of that unit, the Weberg, Warm Springs, and Basey (new) formations; and two Upper Jurassic (Callovian) formations (12,500 feet), the Trowbridge and Lonesome. The Tertiary sequence includes amygdaloidal basalt and mudflow breccia, Columbia River basalt, Mascall (?) formation, an olivine basalt flow, and welded tuff of the Rattlesnake formation.

The Upper Triassic sequence is composed dominantly of fine-grained clastic sedimentary rocks, but also contains intercalated coarse-grained detrital beds and marine volcanic strata. Keratophyre tuffs and sandstones composed of volcanic rock fragments and albite grains are associated with quartz keratophyre tuffs, now recrystallized to dense felsites composed dominantly of quartz and

albite. A thick spilite flow sequence and individual thin flows of felsophyric keratophyre are locally interbedded with the clastic volcanic rocks.

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The Jurassic sequence is characterized by abundant clastic volcanic materials. In the Lower and Middle Jurassic, augite keratophyre tuffs composed of plagioclase (chiefly cloudy albite) and fresh augite crystals, partially devitrified shards and glassy lithic fragments, and a matrix of celadonite(?) comprise, together with associated volcanic sandstones, more than 1500 feet of strata. The presence of clear labradorite grains adjacent to albitized grains in these tuffs suggests that albitization occurred prior to deposition, therefore before or during eruption. Finegrained dacite and quartz keratophyre tuffs containing crystals of quartz, biotite, and plagioclase (andesine or albite) set in a felsitic groundmass of authigenic zeolites, or albite and quartz, occur in the Upper Jurassic, as do great volumes of quartz-bearing volcanic graywacke. The Jurassic section may record the development of a deep trough adjacent to a growing island arc.

The Upper Triassic sequence rests unconformably on folded Paleozoic rocks. An Early Jurassic (Sinemurian) orogeny formed a system of nearly isoclinal folds, with steeply dipping axial surfaces and northerly and northeasterly trending axes. The Jurassic sequence was deposited unconformably upon the folded Triassic strata and was itself folded about easterly and northeasterly trending axes during the Late Jurassic or Early Cretaceous. The later orogeny deformed the older folds in Triassic beds in two ways: steeply plunging cross folds were formed in the isoclinal limbs, and alternating culminations and depressions developed along the crests and troughs. Faulting of several kinds accompanied the Mesozoic deformations, and normal faulting accompanied Tertiary warping.

Microfilm \$6.20; Xerox \$22.05. 487 pages.

STRATIGRAPHY AND OSTRACODA OF THE EXOGYRA COSTATA ZONE OF SOUTHWESTERN ARKANSAS

(L. C. Card No. Mic 60-1462)

Ronald George Drouant, Ph.D. Louisiana State University, 1960

Supervisors: Professors H. V. Howe, G. E. Murray, and C. O. Durham

The stratigraphy and Ostracoda of the Exogyra costata zone which embraces the Saratoga, Nacatoch and Arkadelphia formations of southwestern Arkansas were studied in order to understand more fully the sequence of late Cretaceous events.

The various lithic units were traced on the surface from Little River in Hempstead County to Arkadelphia in Clark County. Approximately 35 sections were measured in detail, and samples from 19 of these provide a representative distribution of ostracods.

The Saratoga formation of this paper includes a lower chalk member and an upper argillaceous-arenaceous unit which has previously been considered a part of the Nacatoch formation. The base of the Saratoga marks the first appearance of abundant sand sized clastics following a long

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period of deposition of the non-arenaceous marls which constitute the Marlbrook formation. A carbonate environment predominated during deposition of the lower Saratoga, but this yielded to argillaceous-arenaceous conditions during deposition of the upper member.

The Nacatoch formation is here restricted to include an upper arenaceous member and a lower glauconitic member. The glauconitic member is a concentrate above an angular unconformity developed upon the chalk and the argillaceous-arenaceous members of the Saratoga formation. During deposition of the upper sand member stable conditions permitted basinward removal of the finer clastic fraction, while the late Nacatoch sea transgressed northward over the beveled edges of older formations depositing sands upon strata at least as old as the Ozan formation.

Toward the end of Nacatoch time the supply of sand sized material was exhausted, and the type of sediments being deposited changed transitionally into clays and marls of the Arkadelphia formation. Depth of water was never great, and two similar marl lithologies were deposited; a fossiliferous marine marl, and a nonfossiliferous brackish to fresh water marl.

Of the 63 species encountered, 9 are new. A check list and range charts reveal that of the 63 species 24 range from Marlbrook to Nacatoch or Arkadelphia, and 6 are confined to the chalk member of the Saratoga. On the basis of the ranges of the remaining 33 species and proportions of species comprising its fauna, the Saratoga formation is considered more closely related to the underlying Marlbrook (Taylor stage) than to the overlying Nacatoch and Arkadelphia (Navarro stage).

Attention is called to the fact that a number of species first appear in the chalk member of the Saratoga and persist throughout the Nacatoch and Arkadelphia. This is interpreted to mean that the first changes leading to a Navarro type fauna were initiated during deposition of the Saratoga formation, perhaps in response to an altered environment resulting in part from the influx of sand sized material then being deposited. These changes became established during the period of erosion following deposition of the Saratoga formation. The large number of species that persist throughout the section investigated indicates that this break is not large in a time sense, even though it is marked by angular discordance.

Microfilm \$2.75; Xerox \$9.70. 211 pages.

THE INFLUENCE OF CLIMATIC FACTORS ON THE GEOMORPHOLOGY OF A PART OF THE COASTAL PLAIN OF NORTHERN ALASKA

(L. C. Card No. Mic 60-1125)

Ralph Sanborn Fellows, Ph.D. Boston University Graduate School, 1959

Major Professor: Professor C. Wroe Wolfe

Climatic factors have influenced the formation of some of the unique geomorphic features of the Coastal Plain of northern Alaska. Emergence of the nearly flat land surface from the sea allowed the cold climate to form a frozen layer of soil and bedrock (permafrost) hundreds of feet deep.

Ice wedges and their attendant polygons—low center type maturing into high center type—are familiar geomorphic features. In many places continued addition of groundice, either as ice wedges or by some other process, has raised the level of the soil several feet, even 10's of feet above the original surface position. "Uplands" may be due to ice accumulation within the soil as well as degradation of valleys. A term such as "cryotumescence", meaning "swollen with ice", "puffed up by freezing", would be useful in referring to this increase in soil volume. Pingos and mounds are, also, formed essentially by freezing and related conditions.

Other common features are the result of melting of the accumulated ice to form depressions in the terrain. Channel and corner pools, beaded streams, ponds and lakes result from the melting of ground ice. Many lakes have been partially drained by downcutting of their outlets and the shallow lake margins have become marshes. Lakes and marshy drained lake basins dominate many parts of the landscape.

Marshes in the drained lake basins are sometimes formed because the elevation of soil barriers in the form of polygon rims may serve as dams across the outlets to retard draining and thus hold the water table at a fixed level or even raise it slightly. Headward erosion by streams eventually captures the lake or pond, lowering it again until another phase of ice accumulation dams the outlet and a marshy zone around the margin begins to form at a lower level. Changes of climate are not required to regulate these episodes of draining and stable water level.

The features produced by the Arctic climate are so distinct that an Arctic cycle of erosion in the youthful stages can be recognized--characterized by such features as thaw lakes, drained lake basins, beaded streams, pingos, lowlands typified by low center polygons, and "uplands" with channel pools and high center polygons.

The most conspicuous features of the Coastal Plain are the countless oriented lakes--elongated in a north-northwest direction. It is maintained that these are, also, due to climatic factors which produce the prevailing eastnortheast winds and, at times, west-southwest winds in

some places.

Sandy soils such as are common to the area are normally moved by unidirectional wind into transverse type dunes--perpendicular to the wind direction. When the Coastal Plain was first exposed to wind action it was, probably, barren of vegetation, and the wind and moving sand kept it so until dunes and enclosed basins were developed. Subsequently, the basins became filled with ground ice either because they were poorly drained or because fine materials settled in them and encouraged ice formation. After vegetation became established on the soil, the formation of longitudinal and parabolic dunes gradually obscured the earlier transverse dunes. The basins being filled with ice were re-established by melting and collapse to form the present thaw lakes with their long axes perpendicular to the prevailing winds and, of course, perpendicular to the present longitudinal dunes.

Microfilm \$2.80; Xerox \$9.70. 214 pages.

A STUDY OF THE VELASCO FORMATION OF NORTHEASTERN MEXICO

(L. C. Card No. Mic 60-1362)

William Winn Hay, Ph.D. Stanford University, 1960

A regional stratigraphic-micropaleontologic study of the Velasco formation of the Tampico embayment region, northeastern Mexico, has been undertaken in order to determine: a) the relationship of the Velasco formation to the Mendez formation and to the Tanlajas formation of the Chicontepec group; b) the conditions of deposition; c) the age of the deposits; and d) the significance of the Mexican section in the Cretaceous-Tertiary boundary problem.

Fifty field localities were visited, and 146 surface samples were taken, eighty-two of which were found to have a microfauna suitable for study. In addition, 168 rotary drill samples from nine wells in the area were obtained and studied.

The fauna examined consists of 134 species of Foraminifera, four species of Ostracoda, and one species of the form-genus Discoaster.

The following conclusions were reached:

- a) The Mendez formation underlies the Velasco formation. The contact between the two is generally conformable and is not readily distinguished in the field. Comparison of the planktonic faunas reveals that an hiatus exists between the two formations. The Velasco formation contains three zones based on planktonic Foraminifera: 1) a lower Globigerina zone characterized by several species of Globigerinids and non-keeled Globorotaliids, which may be divided into a basal Globigerinoides daubjergensis subzone and an upper Globorotalia uncinata subzone; 2) a Globorotalia pseudomenardii zone with an assemblage of keeled Globorotaliids; and 3) a Globorotalia velascoensis zone with an assemblage identical to that of the Globorotalia pseudomenardii zone except that the species Globorotalia pseudomenardii is not present. The three planktonic foraminiferal zones found in the Velasco shale may also be recognized in the sandier Tanlajas flysch formation of the Chicontepec group, so that this is seen to be a facies of the Velasco formation. The Chicontepec flysch encroached upon the Velasco shale from the north and from the south as time progressed, and the Velasco-Tanlajas contact is shown to be time transgressive.
- b) Deposition of the Mendez and Velasco formations took place under conditions of normal marine salinity in waters probably more than 500 meters in depth. The Tanlajas formation was deposited on the sides of the depositional basin in shallower waters. The surface waters were warm during deposition of the Mendez formation, cold during deposition of the Globigerina zone sediments, warm again during deposition of the Globorotalia pseudomenardii zone strata, but slightly cooler during deposition of the Globorotalia velascoensis zone beds.
- c) The Mendez formation is shown to be Campanian-Maastrichtian in age. The Globigerina zone of the Velasco formation is Danian; the Globorotalia pseudomenardii zone is considered Lower Landenian; and the Globorotalia velascoensis zone is considered Upper Landenian. The Velasco formation as a whole is Paleocene.
- d) Although deposition appears to have been more or less continuous throughout Velasco time (Paleocene), the hiatus between the Mendez formation (Campanian-Maas-

trichtian) and the basal Globigerina zone of the Velasco formation (Danian) marks a complete change in the planktonic fauna--a change which is shown to be associated with a world-wide lowering of sea level and cooling of climate. It is suggested that this great event marks the end of the Cretaceous, and that the Danian Stage belongs in the Tertiary.

Microfilm \$5.35; Xerox \$18.90. 420 pages.

GEOLOGY AND ORE DEPOSITS OF THE SOUDAN MINE, ST. LOUIS COUNTY, MINNESOTA.

(L. C. Card No. Mic 60-1495)

Frederick Lindsley Klinger, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Stanley A. Tyler

Keewatin type iron ore found associated with steeply dipping volcanic rocks and sediments of early Precambrian age, form a distinctive class of iron deposits in the Lake Superior area. Such ores occur in the Soudan Mine in the Vermilion district of northeastern Minnesota and in the Steep Rock and Michipicoten districts of Ontario. Previous studies of these areas have led to conflicting hypotheses concerning the origin of Keewatin type ores. The present investigation was undertaken with the purpose of clarifying the nature of the ore occurrence at the Soudan Mine with the object of applying the results of the investigation to the problem of origin.

The methods used in this investigation included detailed geologic mapping of surface and underground areas, lithologic studies of drill core and the microscopic examination of thin sections and polished surfaces.

The ore deposits at Soudan are found in steeply dipping lenticular bodies of siliceous iron formation. The iron formation lies within a complex group of chloritic schists known collectively as the Ely greenstone. These schists are bordered on the south by a belt of sediments previously correlated with the Knife Lake group. Structural relationships observed during this study suggest that the greenstone and included iron formation overlie the southern belt of sediments rather than lying unconformably beneath them as previously suggested.

The Ely greenstone, in the Soudan area, is made up of altered intrusives, flows and fragmental rocks and sediments of widely differing composition. The Soudan area greenstones contrast strongly with the greenstones found elsewhere in the Vermilion district which consist for the most part of altered basic lava flows. Although the Soudan greenstones are highly altered to mixtures of chlorite sericite and quartz, the preservation of many primary textures and structures indicate that the rocks have not been extensively sheared.

The iron formation occurs as a series of complex folds developed in a single belt of iron formation which is commonly separated from greenstone of basic composition by a zone of siliceous and sericitic schists. The iron formation shows mappable variations in lithology which occur in a regular order as chert, lean jasper and jaspilite. The distribution of lithologies is interpreted as a vertical and lateral facies change within the iron formation.

A stratigraphic sequence is proposed which consists of a basal chert succeeded upward by lean jasper and jaspilite.

The ore consists of high grade hematite bodies which have formed by replacement of iron formation. Controls on the occurrence of ore include preferential replacement of jaspilite, intrusive contacts, structurally thinned portions of the iron formation, and to a minor extent, faulted and brecciated zones.

Microfilm \$2.50; Xerox \$5.80. 117 pages.

FOSSIL SILICOFLAGELLATES FROM CALIFORNIA

(L. C. Card No. Mic 60-1383)

York Tooree Mandra, Ph.D. Stanford University, 1958

Silicoflagellates are defined here as marine, planktonic Mastigophora (Protozoa) with a flagellum and a skeleton of hollow siliceous rods. These organisms also contain color pigment organelles and therefore are treated by some authorities as plants (Algae) and by others as an animal-plant group (Protista).

Detailed observations and statistical analyses of California fossil silicoflagellates have been made in order to find morphologic differences which have stratigraphic value. Faunules from the following California time-rock units were studied: one Upper Cretaceous shale; two Upper Eocene "mudstones"; one Middle Miocene, one Upper Miocene, and four Mio-Pliocene diatomites. The most abundant faunules were found in diatomite. This rock seems to be the best natural medium for preserving fossil silicoflagellates. A total of 34 species were identified, and their synonymies are presented in the Systematic Descriptions. A Gazetteer of world-wide silicoflagellate localities is included.

Stratigraphic results of the study are summarized as follows: (1) faunules separated by as much as 300-foot stratigraphic intervals in one stage cannot be statistically differentiated, but faunules from different California stages and series can be differentiated; (2) the genera Vallacerta and Lyramula are restricted to the Upper Cretaceous; (3) the genus Naviculopsis and five species in other genera are confined to the Upper Eocene; and (4) seven species are restricted to the California Miocene. Hence, silicoflagellates at the generic and specific level do have value as another correlation tool.

Ecologic conclusions based upon paleontological collateral evidence and studies of recent silicoflagellates indicate that the lithologic units sampled were deposited in marine waters which had the following surface or near surface temperatures: $0^{\circ}-5^{\circ}$ C. for the Mio-Pliocene Monterey formation (type area), Buttle diatomite (new name), and lower part of the Sisquoc formation (Purisima Hills); $10^{\circ}-15^{\circ}$ C. for the lower part of Mio-Pliocene Sisquoc formation (Lompoc area); $17^{\circ}-20^{\circ}$ C. for the Upper Miocene Valmonte diatomite; 25° C. for the Middle Miocene diatomite at Sharktooth Hill; and $20^{\circ}-25^{\circ}$ C. for the Upper Eocene "Sidney Flat" and Kellogg shales.

The name Buttle diatomite is proposed for a new 500foot thick member of the Monterey formation. The type locality is in Buttle Canyon, about 4 miles WSW. of Bradley. The diatomite is assigned to the Delmontian Stage of California (Mio-Pliocene), and it is the possible equivalent of the Sarmatian Stage of Europe.

Microfilm \$2.50; Xerox \$7.40. 158 pages.

OSTRACODA AND STRATIGRAPHY OF AUSTIN AND TAYLOR EQUIVALENTS OF NORTHEAST TEXAS

(L. C. Card No. Mic 60-1471)

Oscar Lawrence Paulson, Jr., Ph.D. Louisiana State University, 1960

Supervisors: Professor H. V. Howe and
Associate Professor Clarence O. Durham, Jr.

This study was undertaken to correlate the Austin group of central Texas and its equivalents in northeast Texas and, also, to determine the relationships between the Austin and Taylor equivalents of northeast Texas.

Poorly exposed outcrops in northeast Texas were studied in detail, and, in supplement, well cuttings in the Bureau of Economic Geology Well Samply Library at Austin were examined. The correlation value of a number of megafossils has been evaluated, and the ranges of some have been extended in local areas as a result of this study.

In a special study, Austin and Taylor Ostracoda of northeast Texas were compared with ostracod slides prepared by Professor H. V. Howe from samples collected by Louis A. Gimbrede in central Texas.

The carbonate sequence of the Austin group of central Texas is separated from its clastic equivalents in northeast Texas by the Preston anticline which trends northwest-southeast in Grayson and Hunt counties. Previous correlations have been made between the carbonate and clastic sequences, but this study has necessitated a number of revisions. Some of the species ranges have been strongly controlled by environment while others have not, and the boundary between the Austin and Taylor groups of central Texas and between their equivalents in northeast Texas is transitional in some areas and unconformable in others.

Microfilm \$2.50; Xerox \$6.20. 127 pages.

PERMIAN SEDIMENTARY FRAME WORK OF THE FOUR CORNERS REGION

(L. C. Card No. Mic 60-1506)

Gerald Lee Scott, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor L. M. Cline

The Four Corners region, centered at the juncture of Colorado, Utah, Arizona, and New Mexico, contains Permian rocks of Wolfcampian-Leonardian age which exhibit some complex facies changes. Arkosic red bed facies in southwestern Colorado and northwestern New Mexico grade into light-colored, cross-bedded sandstone facies in southeastern Utah and northeastern Arizona. Fossiliferous carbonates locally occur in the lower and uppermost parts of the Permian interval. Detailed isopach and initial

lithofacies map analysis employing critical subsurface data reveal, together with heavy mineral study, new insight to the complex Permian history. Facies relations, sedimentary structures, and poorly-preserved foraminifera discovered by the writer cast doubt upon the popular concept that all Permian terrigenous strata in the region are non-marine.

The White Rim sandstone of Utah is physically continuous with the sandstone of the eastern phase of the Toroweap formation. Furthermore, the White Rim in western Monument Valley, Utah, gradationally overlaps the DeChelly sandstone. The White Rim, which is partly an eastern facies equivalent of the marine Kaibab limestone, may be a beach deposit.

The aeolian Arizona Coconino sandstone and so-called Utah "Coconino" are not physically continuous in the subsurface. The Utah "Coconino" may be marine on the basis of the marine or marginal marine origin postulated for its two tongues, the White Rim and the Cedar Mesa. The Cedar Mesa sandstone is inferred to be a spit-like bar deposit because of spacial considerations, subaqueous (?) structures, locally persistent horizontal bedding, and rare marine microfossils.

The Cedar Mesa sandstone changes abruptly to the southeast into the gypsiferous and red clastic "Cedar Mesa evaporite." Lenticular configuration suggests deposition in a confined, elongate basin. Proximity to the Cedar Mesa sandstone and rare foraminifera imply replenishment of saline water from westerly seas.

Some upper Cutler sandstones of the so-called "non-marine" red bed facies bear significant numbers of marine microfossils and shell fragments in the Big Indian Wash locality, Utah.

High brown tourmaline content and low zircon:tourmaline ratio in light-colored, cross-bedded sandstones as contrasted with Uncompander-derived arkosic facies sandstones confirm earlier cross-bed references which indicate a northern quartz sand source distinct from the Uncompander. The source of the light-colored sand possibly was in central Utah.

The Emery uplift and the Green River arch, extending southward from the uplift into northwesternmost New Mexico, formed an eastern limit of clear, quartz sand deposition. Those tectonic elements were a western margin of the Paradox zeugogeosyncline, which effectively trapped all debris from the northern Uncompandere. The eastern flank of Emery uplift also was a prominent locus of fossiliferous carbonate deposition during Wolfcampian time.

Between the Paradox zeugogeosyncline and the "San Juan basin" of New Mexico an area of decreased subsidence caused by-passing of red Uncompander-derived clastics and an anomalous westward continuation of such clastics into southernmost Utah and northernmost Arizona. However many red beds in the Grand Canyon area possibly had their source in central Utah.

The Zuni-Defiance uplift which straddled the Arizona-New Mexico boundary confined Uncompander clastics in a manner analogous to that of Green River arch and Emery uplift. The Zuni-Defiance uplift, perhaps a minor red clastic source, and Green River arch partially limited "Cedar Mesa evaporite" and silt-clay deposition.

Microfilm \$2.50; Xerox \$6.60. 137 pages.

THE GEOMORPHOLOGY OF PART OF THE SAN FRANCISCO PENINSULA, CALIFORNIA.

(L. C. Card No. Mic 60-1375)

David Dwyer Smith, Ph.D. Stanford University, 1960

This study deals with the upland surfaces and flanking marine terraces present on Montara Mountain on the San Francisco Peninsula, and with the geomorphic features related to and displaced by the San Andreas fault system which transects the peninsula.

Three separate marine terrace sequences are present:

1) the Half Moon Bay sequence southwest of Montara mountain with four terraces at elevations of 100 to 400 feet;

2) the Mussel Rock sequence northwest of the mountain consisting of one compound, tilted terrace at 0 to 260 feet; and 3) the Colma sequence, northeast of the mountain, which includes three terraces at 200 to 500 feet. The lowest terrace in each sequence can be correlated on the basis of topographic position, degree of preservation, and soil development. Correlation with marine terraces farther south dates them as Sangamon in age. Correlation of the higher terraces was not possible.

The Half Moon Bay and Colma sequences are similar to typical California marine terrace sequences. The Mussel Rock terrace, however, is an atypical fill terrace which overlies a complicated section of Pleistocene beds, and was apparently produced by depression of a structural block along border faults.

The pronounced upland surfaces, the Sawyer and the Buri Buri, are present along the northeast flank of Montara Mountain. The Sawyer Upland is composed of a series of narrow interconnected, relatively flat ridge crests at 1,000-1,250 feet, and occurs only southwest of the San Andreas fault. No conclusion was reached regarding its origin.

The Buri Buri Upland with one exception is restricted to the northeast side of the San Andreas fault and is 300 to 600 feet below the Sawyer. It consists of two closely related but distinct geomorphic facies: the rolling facies and the flat facies. The rolling facies, which consists of hilly to gently rolling topography at 600-900 feet, is apparently a late mature stream-eroded surface, and is probably early to middle Pliocene in age or older. An isolated element of this facies is present on the opposite (southwest) side of the fault 10 miles northwest of the main area.

The flat facies consists of strikingly flat topography at 600 feet and originated as a strath modification of the late mature facies. It was produced by stream erosion which stripped away the Plio-Pleistocene Merced formation and then reduced the exhumed pre-Merced surface, probably in early Pleistocene or very late Pliocene time.

Although the San Andreas fault has a history of right-lateral strike-slip offset, the coastline where the fault enters the sea is anomalously straight, particularly in view of the contrast in rock hardness and topography on opposite sides of the fault. Based primarily on correlation of a Sangamon terrace across the fault, post-Sangamon offset along the fault in the area has been negligible. By contrast, the marked offset in the coast about 5 miles to the south where the Pilarcitos fault enters the sea suggests late Pleistocene strike-slip offset along this fault. The juxtaposed relationship of markedly different topographies, geologic structures, and lithologies, and other geomorphic evidence support this.

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The present configuration of the peninsula apparently results from successive middle and late Pleistocene juxtaposition of three distinct structural blocks characterized by dissimilar structures, lithologies, and geomorphic features, produced by right-lateral strike-slip movement along the San Andreas and Pilarcitos faults. Pre-Sangamon Pleistocene offset along the San Andreas totals at least 10 miles; late Pleistocene offset along the Pilarcitos is probably about 3 miles and possibly more. Pleistocene displacement on the peninsula apparently has been episodic.

Microfilm \$5.55; Xerox \$19.60. 433 pages.

OSTRACODS FROM THE MIDDLE DEVONIAN
TRAVERSE GROUP OF EMMET AND CHARLEVOIX
COUNTIES OF MICHIGAN

(L. C. Card No. Mic 59-4990)

Jane Elizabeth Inch Smith, Ph.D. University of Michigan, 1959

The ostracod assemblage from the Traverse group, Middle Devonian, of the northwestern part of the Southern Peninsula of Michigan was studied comprehensively. Samples were collected from the three lithologic divisions which constitute the group in this region; in ascending order, the Gravel Point, the Charlevoix, and the Petoskey formations.

Classification of the ostracods shows 50 genera represented by 85 species and two varieties, which are described and illustrated. Three genera, 26 species, and two varieties are proposed as new. They include: Dictyogramma scabratum*, Paraschmidtella costata, Rhyncobolbina tuberculata*, Falsipollex abstersus, Subligaculum tuberculolobatum, Dizygopleura tenella, Kloedenella robustior, K. trisulca, K. epigrapta, Aechmina asymmetrica, Phlyctiscapha dubia, Bythocyproidea iniqua, B. iniqua var. similis, B. triangulata, Octonaria laevilatata Kesling and Kilgore var. plana, Bairdia glabra, B. immatura, B. prolixa, Bythocypris cuneata, B. homala, B. ampliata, Parabufina aurita, Quasillites magnispinatus, Q. craticulus, Bufina coloba, Pedilitys notata*, Euglyphella infucata, E. nexilocostata. The names of the species are starred.

Abundant specimens were found in the Gravel Point and Petoskey formations. The Charlevoix formation yielded no microfossils. The general character of the ostracod fauna of the former two units is found to be homogeneous, 33 species being common to the two.

The assemblage is typically Middle Devonian and re-

sembles those reported from other areas of the Traverse group in the Michigan Basin and of the Hamilton group in New York State.

Microfilm \$2.90; Xerox \$10.15. 224 pages.

STRATIGRAPHY AND OSTRACODA OF THE RIPLEY FORMATION OF WESTERN GEORGIA

(L. C. Card No. Mic 60-1472)

Raymond Weathers Stephens, Jr., Ph.D. Louisiana State University, 1960

Supervisors: Professors Grover E. Murray,
Clarence O. Durham, and Henry V. Howe

The Ripley formation (Gulfian) and its bounding formations in western Georgia were studied stratigraphically from the Chattahoochee River on the west to the Ocmulgee River on the east. Surface exposures were measured and described in detail and ostracod samples and rocks for thin sections were collected for study. An outcrop map of the Ripley formation with the geographic location of the measured sections and a stratigraphic cross section with the position of all ostracod samples and rock thin sections are enclosed in the pocket.

The Ripley extends eastward into Georgia from Alabama and crops out from the Chattahoochee River to the Flint River where it is overlapped by the more northerly striking Providence sand. In western Georgia, the Ripley is composed of a nearshore marl that predominates updip and an offshore find marine sand and clay that predominates downdip. The offshore sand and clay extend eastward to the Flint River with very little facies change but thin from approximately 150 feet in the Chattahoochee River valley to approximately 50 feet in the area of the Flint River.

East of the Flint River, the Providence sand overlaps the Ripley and lies unconformably upon the Cusseta sand. In Twiggs County, evidence suggests that the commercial kaolin is in beds of Cusseta and Providence ages where the Tertiary has overlapped both formations.

A total of 37 species of Ostracoda have been found in the Ripley as a result of this investigation. Twenty-seven of these species have been reported previously. Of the remaining 10 species, four are described as new in this dissertation. On the basis of the ostracods, the Ripley of Georgia can be correlated with the Saratoga formation of Arkansas and the Peedee formation of North Carolina.

Microfilm \$2.50; Xerox \$5.80. 118 pages.

HEALTH SCIENCES

HEALTH SCIENCES, GENERAL

THE INFLUENCE OF DOSE LEVEL ON THE DISTRIBUTION AND ELIMINATION OF INORGANIC MERCURY

(L. C. Card No. Mic 60-1326)

Herman Cember, Ph.D. University of Pittsburgh, 1959

The influence of the size of a dose of inorganic mercury on the distribution and elimination of mercury was studied by intraperitoneally injecting three groups of rats with 1, 10, and $100\,\mu\mathrm{gm}$. mercury as mercuric nitrate, serially sacrificing the rats over a 70-day period, and analyzing the organs of the animals for mercury. The excreta from the four rats in each group that were kept for 70 days were collected and analyzed for mercury. The mercuric nitrate was labelled with mercury 203, and all mercury determinations were made radiometrically.

The kidneys, liver, and skeleton were found to be the organs in which major fractions of the mercury were concentrated; the kidneys stored the most, while the skeleton concentrated the least of thise three organs. Relative amounts of mercury in the skeleton and liver were not influenced by the size of the dose; the mercury burden in the kidney was found to increase with increasing dose.

Fecal execretion was found to be a major avenue of elimination in all cases. However, as the size of the dose increased, the urine was found to play an increasingly important role during the day immediately after injection.

A mathematical model for the distribution and elimination of mercury based on first order kinetics was postulated and was found to be compatible with the data.

Microfilm \$2.50; Xerox \$7.20. 154 pages.

STUDIES IN HYPOTHERMIA AND STAPHYLOCOCCUS TOXIN SHOCK

(L. C. Card No. Mic 59-6065)

William Robert Cole, M.D., Sc.D. University of Cincinnati, 1959

Circulatory collapse due to sepsis is a well-recognized clinical entity. In our experience it occurs more frequently than would generally be expected in spite of the use of modern antibacterial agents. The purpose of this work has been to evaluate the merit of generalized hypothermia as an adjunct to the therapy in a type of septic shock. In the past there have been conflicting reports in the literature on the value of hypothermia in the treatment of various other types of shock, and recently there have been reports on its value in the treatment of various experimental surgical infections. I feel these reports justify this investigation.

Methods

Using the lethal exotoxin of Staphylococcus aureus, a standard type of death was produced in mixed breed domestic rabbits with weights varying from 1 to 2.5 kilograms. Each test animal was paired with a control animal. The first series of experiments consisted of nine groups of four animals anesthetized with 30 milligrams per kilogram of nembutal intraperitoneally. Two of these animals were cooled by emersion to 28° C ± 2 degrees and two were allowed to maintain their normal body temperature while exposed to room temperature. All animals had a canula placed in the femoral artery using sterile technique and a catheter was placed in the urinary bladder. One Normothermic and one hypothermic animal were given a standard 0.25 cc. dose of a 1:10 dilution of the staphylococcus exotoxin. This dose was found to kill all animals so treated in 1 to 24 hours. The animals were then observed and the blood pressure, pulse, respiration, blood urea nitrogen, hematocrit, and urinary out-put were measured before giving the toxin and intermittently after giving the toxin. The time of death was recorded and a complete autopsy was done on all animals. Blood cultures were taken before and at intervals after the toxin was given.

The second series of experiments was done on six groups of twelve rabbits each. Each group contained eight rabbits who were made hypothermic with rectal temperatures ranging from 26-30°C following a standard dose of 30 milligrams of nembutal per kilogram. The remaining four animals were given the 30 milligrams per kilogram of nembutal and allowed to remain normothermic exposed to room temperature. The normothermic animals and four of the hypothermic animals were given a standard 0.75 cc. per kilogram dose of the Staphylococcus aureus exotoxin diluted 1:10. The animals were then observed and the time to death recorded. The blood packed cell volumes and the white blood counts were done on the last two groups before and one hour after injection of the toxin.

Results.

Measurements of survival following an intravenous injection of Staphylococcus aureus toxin failed to reveal any significant difference in the hypothermic and the normothermic animals. The average survival of the normothermic animals was 10.5 hours and that of the hypothermic 4.2 hours. The average fall in the packed cell volume of the blood was 6.38 volumes percent for the hypothermic and 8.85 volumes percent for the normothermic groups. These were not significantly different when subjected to the "t" test. The average fall in white blood count was 640 per cubic millimeter in the hypothermic animals and 440-8 per cubic millimeter in the normothermic group. These changes are not significantly different. The urinary out-put varied widely in the shock period, but no significant difference was noted between the two test groups.

The gross and microscopic examination of the animals revealed nonspecific congestion of all of the organs. The most marked changes were seen in the lungs where there there was severe congestion and atelectasis but without inflammatory reaction. The kidneys showed congestion of the glomeruli in an irregular distribution. There was no obvious difference in the severity of the changes in the two test groups. These changes were not seen to any significant degree in the control group.

The conclusion has been drawn from this work that induced general hypothermia has no effect upon the survival time of the experimental animal used when challenged with this specific type of septic shock.

It has also been observed that hypothermia does not alter the hematologic or the histologic effects of the Staphylococcus exotoxin when used in the rabbit.

Microfilm \$2.50; Xerox \$3.00. 15 pages.

A STUDY OF SOME OF THE BIOLOGICAL ACTIONS OF VANADIUM

(L. C. Card No. Mic 59-3424)

Charles E. Lewis, M.D., D.S.I.M.
University of Cincinnati, 1959

This thesis has been arbitrarily divided into four sections. The first section consists of a literature review of studies on the biological effects of vanadium. This covers the earliest work by Priestley, and the period in the early 1900's in which vanadium found wide use as a panacea in Europe. It also reviews the literature on the effect of vanadium on cholesterol synthesis. The last portion of the first section reviews the available papers on the effects of occupational exposure to vanadium.

The second section describes the original work done on the evaluation of the effect of vanadium upon serum cholesterol levels in men exposed to and absorbing vanadium as a consequence of their employment. Twenty-four vanadium for at least 6 months were examined. These men were divided into two geographical areas -- Ohio and Colorado. A similar group of controls (47 men) selected at random from a much larger group of volunteers, received the same examination. This examination consisted of a detailed history, and physical examination, urine analysis, electrocardiogram, serum cholesterol determination, hematocrit, and an analysis of urine for its content of vanadium. The results of these cholesterol analyses were analyzed by a multiple regression technique. In this way, any possible bias within the control and exposed groups, with respect to age, height, weight, race, alcohol and fat intake were minimized. Results indicate that the serum cholesterol levels of the vanadium exposed group were significantly lower than those of the controls.

Air sampling for the concentration of vanadium in the working environment was done in both Colorado and Ohio. Particle size determinations were also made on these samples. The air concentration of vanadium ranged from 0.1 to 0.3 mgs/m³. The levels of vanadium in urine were significantly higher in the vanadium workers than in the control group. There was no difference in the results of urine analyses or the incidence of abnormal electrocardiograms between the two groups.

There was no significant effect of vanadium exposure upon the hematocrits. The effect of altitude (Colorado

versus Ohio) was significant in that the Colorado group (exposed and controls) had increased red cell volumes.

Section 3 describes the symptoms and signs observed in vanadium workers in contrast to those medical findings in the control groups. A significantly higher incidence of cough, eye, nose and throat irritation and green discoloration of the tongue was found in the vanadium workers. There was also objective evidence of this irritation of mucous membranes.

Section 4 consists of a report of a series of exploratory experiments on the effect of vanadium on (1) the electrocardiogram of the dog, (2) the excretion of 5-hydroxy indoleacetic acid and amino acids in the urine of the dog. It has been suggested that vanadium might be a co-factor for monoamine oxidase. This enzyme is important in the metabolism of serotonin (5-hydroxy tryptamine). There is some similarity between the physical signs and symptoms seen in the malignant carcinoid syndrome, where there is an excess of circulating serotonin, and in men suffering from vanadium poisoning. These series of experiments indicated the following:

- Vanadium injection into dogs produces a significant decrease in the excretion of 5-hydroxy indoleacetic acid, the major metabolic product of serotonin metabolism.
- 2. The excretion of 5-HIAA is a function of urine volume in normal dogs and in those treated with vanadium.
- 3. Vanadium injections in the range of 2.5 to 5.0 mgs/kg of sodium metavanadate produce an alteration in the pattern of amino acid excretion in dog urine.
- 4. Intravenous injection of vanadium produced a consistent series of alterations in the electrocardiogram of the dog. These consist of an initial increase in T-wave amplitude, and subsequent depression of the ST segments and clockwise rotation of the mean T wave vector in space.
- The symptoms seen in dogs after vanadium (apnea, hyperperistalsis, pallor) were those reported by previous investigators.

In the course of these experiments, three dogs expired at varying intervals after the administration of vanadium. Pathologic changes were consistent with previous reports of injury to the liver and renal tubules by vanadium.

Microfilm \$2.50; Xerox \$7.00. 146 pages.

HEALTH SCIENCES, NUTRITION

BIOTIN REQUIREMENT OF THE GUINEA PIG

(L. C. Card No. Mic 59-5661)

Gertrude LeAnn Borchers, Ph.D. Iowa State University of Science and Technology, 1959

Supervisor: Dr. Charlotte E. Roderuck

Biotin deficiency was produced in guinea pigs 3 to 7 days old by feeding an avidin concentrate and a biotin-deficient synthetic diet.

The first symptoms observed were reduced weight gains and reduced food efficiencies. Average daily weight gains ranged from 3.1 to 5.6 grams for control guinea pigs and from 0.0 to 2.5 for biotin-deficient guinea pigs; food efficiencies ranged from 0.22 to 0.46 grams of weight gained per gram of food eaten for control guinea pigs and from 0.00 to 0.22 for biotin-deficient guinea pigs. Six of 10 biotin-deficient guinea pigs achieved maximum weight from 18 to 23 days after the experiment began; thereafter their weights declined.

Biotin-deficient guinea pigs developed an unthrifty appearance which was a combination of gauntness and cottony fur. Dermatitis appeared in several instances, but was slight and did not persist. Biotin-deficient guinea pigs had thinner hair than their controls, but only two guinea pigs had denuded areas. One guinea pig lost some of its hair color, but since most of the guinea pigs were albinos, possible effects of biotin deficiency on hair color could not be evaluated. As deficiencies became severe guinea pigs collapsed and died. Animals which collapsed prior to autopsy did not differ in gross appearance from those sacrificed before collapse.

Biotin-deficient guinea pigs had reduced concentrations of biotin in their livers. The highest concentration of hepatic biotin associated with the symptoms of moderate to severe biotin deficiency in guinea pigs was 0.32 mcg. per gram of liver; livers of control guinea pigs averaged 0.59 mcg. biotin per gram.

Hemoglobin concentrations and red blood cell volumes of biotin-deficient animals were similar to their controls, although two guinea pigs of the deficient group had very low hemoglobin concentrations and red blood cell volumes. Concentrations of nonprotein nitrogen in the blood of biotin-deficient guinea pigs varied widely as did concentrations of their controls, but with one exception were within the normal range. Concentrations of blood urea also varied widely but all values were within the normal range.

Three guinea pigs in the avidin-fed group appeared to have an infiltration of fat and/or degenerative changes in the renal cortex; however, renal fat concentrations in the biotin-deficient guinea pigs were not elevated above concentrations of their controls. Renal weight-body weight ratios were larger in deficient animals than in controls.

Although concentrations of hepatic nitrogen, fat, and moisture were unaffected by biotin deficiency, liver size was reduced both in absolute weight and in proportion to body weight.

Four of 10 biotin-deficient guinea pigs had hemorrhagic adrenal glands. Adrenal glands of biotin-deficient guinea pigs were larger than those of their controls whether expressed in terms of final body weight or maximum body weight. These changes in size plus variable changes in

adrenal cholesterol concentrations of biotin-deficient guinea pigs indicated that guinea pigs were in different stages of the adaptative syndrome as a result of the stress of the deficiency.

Certain symptoms observed in biotin-deficient guinea pigs might have been secondary changes; failure to obtain symptoms previously observed in other species may be due to the relatively acute condition which lead to death as a result of adrenal failure.

Changes in the adrenal, hepatic, and renal weight-body weight ratios observed in the biotin-deficient guinea pigs may have resulted from caloric insufficiency. Similar changes have been reported for other vitamin deficiencies and hence are not specific for biotin deficiency.

Microfilm \$2.70; Xerox \$9.40. 208 pages.

RELATION OF PROTEIN UTILIZATION TO NITROGENOUS COMPONENTS OF BLOOD AND URINE IN WOMEN

(L. C. Card No. Mic 59-5672)

Rose Tung-pei Liu Mao, Ph.D. Iowa State University of Science and Technology, 1959

Supervisor: Lotte Arnrich

The pattern of utilization of nitrogen by women living on different planes of protein intakes and the relationship of various nitrogenous components of plasma and urine to protein intake and retention in women have been investigated.

Four women served as subjects for a two-period study. The first period on a self-chosen diet was followed by a period in which the protein intake was increased by a constant amount (Series 1). Six women were studied during a 10-day period (Series 2). In addition, three women were observed for four periods during which the protein intake was varied (Series 3). In this last series following a 5-week period on a self-chosen diet the subjects were asked to repeat the dietary pattern established three more times. During one period the protein intake was increased by a constant amount, while it was decreased below the established level in another period. These changes were made with a minimum change in the caloric intake.

Nitrogen balances were determined daily on subjects in all three series. Analyses for urinary nitrogenous components were made at given intervals, and determinations for plasma nitrogenous constituents were made once at the end of each dietary period in subjects in Series 2 and 3.

Four of the six subjects in Series 2 were in negative nitrogen balance in spite of the relative adequacy of protein intakes. Though most of the women in Series 1 and 3 were either in a state of continuous nitrogen retention or of nitrogen equilibrium, their self-chosen diets had not furnished protein in amounts sufficient to maintain an optimal level of body reserves of this nutrient. With a daily addition of a constant amount of protein in their diets, the amount of nitrogen retained increased persistently except in one subject who had the greatest magnitude of nitrogen retention in the group.

Total urinary nitrogen, plasma non-protein nitrogen, urinary uric acid, urea nitrogen and creatine in plasma

and urine were directly related to nitrogen intakes. Plasma and urinary creatine, creatinine, or their sum might be correlated with nitrogen retentions. No correlation was observed between plasma uric acid and protein utilization.

It might be possible that several of these components may be useful in the evaluation of protein nutrition in individuals in combination with data provided by balance tests or as indices of protein nutrition in the survey of population groups. However, sufficient evidence is not available to indicate that any one of these substances per se may be used as an index of protein nutrition of an individual.

Microfilm \$3.05; Xerox \$10.40. 233 pages.

HEALTH SCIENCES, PHARMACY

Minrollin \$2.70. Xerox 38.40. 200 percent

A STUDY OF THE REDUCING EFFECT OF ULTRASONICS ON THE PARTICLE SIZE OF CERTAIN PHARMACEUTICAL POWDERS IN SUSPENSION

(L. C. Card No. Mic 59-6270)

Oscar Eduardo Araujo, Ph.D. Purdue University, 1957

Major Professor: Patrick F. Belcastro

The purpose of this project was to determine the extent to which the particles of certain suspended medicaments would be reduced by exposure to various intensities of ultrasonic energy for fixed periods of time. These effects were studied by comparing the rate of sedimentation and the particle size of control, or non-insonated, samples with the results obtained for insonated samples. A study was also made to show the possibility of further particle reduction by addition of certain protective colloids and deflocculating agents.

The techniques used in studying the various suspensions consisted of a spectrophotometric procedure, an elutriation method, and the use of the Andreasen pipette to obtain a complete particle size distribution of the suspended me-

dicaments.

The following effects were observed:

1. The effect of intensity of ultrasonic energy appeared to indicate that a greater reduction in particle size occurred with progressively higher intensities.

2. From this study, it was noted that the longer the suspension was subjected to insonation, the more pronounced seemed to be the reduction in particle size.

3. The variation in degree of the particle size reduction obtained with each of the different compounds studied would indicate that the chemical and physical structure of the substance had an influence on the ultimate effect of ultrasonic energy.

4. Employing the described techniques, it was observed that the higher the initial concentration of the suspended medicament, the less pronounced appeared to be the reduction of the particle size by insonation.

5. The most satisfactory method of evaluation studied was that employing the Andreasen pipette, which provides data for calculation of a complete particle size distribution of the medicament in suspension.

6. The addition of a protective colloid and a dispersing agent appeared to reduce particle flocculation in the suspensions and enhance the ultimate effect of ultrasonics on the particle size of the suspended substance.

7. In view of the results of this study, it is suggested that further investigation should be made using criteria of suspension stability other than particle size.

Microfilm \$2.50; Xerox \$7.00. 148 pages.

THE COMPARATIVE STUDY OF MONOAMINE OXIDASE IN RELATION TO DEOXYRIBONUCLEIC ACID OF NORMAL AND CIRRHOTIC HUMAN LIVER

(L. C. Card No. Mic 60-1554)

Kantilal Girdharlal Bhansali, Ph.D. State University of Iowa, 1960

Chairmen: Drs. J. A. Clifton and J. L. Lach

A study of monoamine oxidase activity in liver tissue has been made. The livers of patients ill with or dead from a wide variety of diseases have been examined. As a rule patients having fatal diseases in which the liver was not histologically altered showed normal enzyme activity. Whereas, patients ill or dead from diseases that produced serious alteration of liver histology showed decreased levels of monoamine oxidase activity. This was especially true of patients with cirrhosis of the liver. The total liver nitrogen and the liver mitochondrial nitrogen were relatively unaltered by these diseases. Liver deoxyribonucleic acid was considerably higher in those patients with severe liver injury than in the control group. However, there were numerous exceptions in all parameters studied. It appears as if age may play some part in manoamine oxidase and deoxyribonucleic acid values since the younger patients tended to have somewhat higher values for these substances than did the adult age groups. In this study deoxyribonucleic acid did not prove to be a reliable reference material upon which to base enzyme activity since there was considerable fluctuation of values in all groups of patients and in particular, the rise in deoxyribonucleic acid in cirrhotic livers seemed mainly to be due to infiltration with white blood cells. Whole liver nitrogen and mitochondrial nitrogen seem to be equally valid as reference substances for monoamine oxidase activity. Rats maintained on a pantothenic acid deficient diet also showed a decrease in monoamine oxidase activity and a rise in deoxyribonucleic acid of the liver.

Microfilm \$2.50; Xerox \$3.00. 53 pages.

THE USE OF NONIONIC SURFACTANTS IN THE DEVELOPMENT OF A HYDROPHILIC OINTMENT

(L. C. Card No. Mic 59-6261)

Charles Thomas Lesshafft, Jr., Ph.D. Purdue University, 1955

Major Professor: H. George DeKay

Skin irritations caused by Hydrophilic Ointment U.S.P. XIV have been attributed to its sodium lauryl sulfate

content (1). The nonionic surfactants, as a group, have been found to be less irritating than the anionics (2,3). Therefore, it would seem advisable to find a nonionic replacement for sodium lauryl sulfate. The primary purpose of this project was to find a suitable nonionic surfactant, or combination of them, to replace sodium lauryl sulfate in the official hydrophilic ointment.

Water loss occurring in this type of ointment base has always been a matter of concern. Until now no satisfactory method has been established in which all factors affecting the rate of evaporation were controlled. It is very possible that the nonionic surfactants may vary in their effect on the water retention property of the base. Therefore, a secondary objective was to develop a method for determining the rate of loss of water from ointments and to determine the effect of various nonionic surfactants on the water retention property of the base.

Forty seven nonionic surfactants were screened for their ability to replace sodium lauryl sulfate in the formula for Hydrophilic Ointment U.S.P. XIV. Thirteen of these were selected for a more complete evaluation. This consisted of determining the stability and compatibility of the ointments prepared with one, three, and five per cent concentrations of the surfactants. Measurements employing the use of the penetrometer were made to detect changes in the consistency of the ointments caused by storage at elevated and reduced temperatures as compared to storage at room temperature. Brij 35* was found to be the most suitable hydrophilic nonionic surfactant tested for use in this formula.

It is generally accepted that a combination of a hydrophilic and a hydrophobic surfactant will produce a better ointment than when the hydrophilic agent is used by itself. The most logical hydrophobic agent to use in combination with Brij 35 is Brij 30 since it is of the same chemical type as Brij 35. The following formula was selected after trying various combinations of the two agents.

Brij 35	4.5
Brij 30	3.5
Stearyl Alcohol	21.5
White Petrolatum	21.5
Distilled Water	37.0
Propylene Glycol	12.0
Methylparaben	0.025
Propylparaben	0.015

A method was developed for determining the rate of water lost from ointments in which all factors affecting the rate of evaporation were controlled. The effect of one, three, and five per cent concentrations of thirteen nonionic surfactants on the rate of water lost from an ointment base was determined. It was found that both the concentration and type of surfactant were factors in the water retention property of the base.

The compatibility and stability of the nonionic base was found to be superior to the official ointment. The nonionic base lost less water than Hydrophilic Ointment. Only a small change in the consistency of the nonionic base occurred upon storage whereas the official ointment increased considerably in consistency. The nonionic base was compatible with a larger number of the agents used in testing the compatibility of the bases.

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Microfilm \$2.50; Xerox \$5.40. 108 pages.

*Trademark name of Atlas Powder Co., Wilmington, Delaware.

HEALTH SCIENCES, PUBLIC HEALTH

DUODENAL ULCER IN EXECUTIVES WITH CONSIDERATION OF METHODOLOGICAL PROBLEMS OF FORMULATING AN ASSOCIATION INDEX

(L. C. Card No. Mic 60-1333)

James Philip Dunn, M.D., Dr.P.H. University of Pittsburgh, 1959

Duodenal ulcer is a common disease entity but the natural history of the condition is such that the majority of cases do not require hospitalization. These cases must be found in the general population.

The present study was concerned with the development of an association index for duodenal ulcer that could be used for population studies. It dealt with the use of radiological criteria as the basis for "true" classification and the need for considering observer variation before accepting these criteria. A clinical questionnaire pertaining to gastrointestinal symptoms was developed as a potential, inexpensive association index.

The data acquired made it possible to form several estimates of the prevalence of duodenal ulcer in a group of executives. Comparison of the executives and a group of craftsmen in regard to prevalence of ulcer disease was made. Finally, the association of duodenal ulcer and serum pepsinogen values respectively with certain characteristics of the individual was studied.

A group of 377 male executives primarily in the fourth through the sixth decades who were undergoing a periodic examination provided most of the data upon which this study was based. Each man had a routine gastrointestinal X-ray examination, completed questionnaires pertaining to gastrointestinal symptoms and personal characteristics, and had a serum pepsinogen determination made. There were independent readings by three radiologists on 116 sets of gastrointestinal X-ray films. Data on a group of 309 craftsmen for ulcer diagnosis and serum pepsinogen values were also available.

Analysis of these data revealed that there was an interobserver and intra-observer variation of 25 per cent and 17 per cent respectively in the reading of gastrointestinal X-ray films. An association index based upon several gastrointestinal symptoms had a sensitivity of 65 per cent and a specificity of 95 per cent when compared to the agreed radiological diagnosis of three radiologists. The prevalence rate of ulcer disease in the executive population was nine per cent based upon a positive history alone and approximately 20 per cent when based upon X-ray classification. The executives had a higher mean serum pepsinogen value and a greater frequency of ulcer disease than did the craftsmen. The data suggested that duodenal ulcer individuals smoked more cigarettes, married at a later age and reported more family history of ulcer disease than did non-ulcer individuals. Those men with high serum pepsinogen values tended to marry at a later age and to report more family ulcer disease than men with low values.

The following conclusions were drawn:

- 1) Observer variation in the interpretation of gastrointestinal X-ray films must be considered as an important factor in avoiding misclassification of individuals regarding duodenal ulcer.
- An association index for duodenal ulcer had sufficient sensitivity and specificity to make it useful for population studies.
- 3) Executives are a high risk group as regards development of duodenal ulcer as witnessed by a high prevalence rate and a high mean serum pepsinogen value.
- 4) Suggestive associations between duodenal ulcer and serum pepsinogen respectively and personal characteristics of an individual deserve further study.

Microfilm \$2.50; Xerox \$6.00. 122 pages.

HISTORY

HISTORY, GENERAL

THE RELIGIOUS IDEAS OF SOME MAJOR EARLY WRITERS OF AMERICA

(L. C. Card No. Mic 60-383)

Robert Walter Root, Ph.D. Syracuse University, 1959

Supervisor: Antonio Pace

This study was undertaken to relate to each other the religions of the chief early American writers, to discover major streams of religious thought, and thus to improve our understanding of American literature and culture. To this end, writers were chosen for their prominence in literature, or life, or both. Their work was examined to learn whether they believed in God as terrible judge or merciful father; in man as inherently sinful or good; in salvation through faith or works; in God's transcendence or immanence; and other related questions.

The Puritans established a theocratic religious pattern in American life on lines of orthodox Christianity--Pauline, Augustinian, or Calvinist. Revolting against this were the first sectarians, Roger Williams, whose faith demanded freedom of conscience, and Anne Hutchinson, who believed God spoke to her mystically.

In the Eighteenth Century, orthodoxy was reaffirmed by Jonathan Edwards. He both preached an ultra-Calvinist view of God and advanced revivalism and evangelicalism by his emphasis on emotion; his Freedom of the Will revitalized the Puritan view of man's finitude. By contrast, John Woolman, Quaker and sectarian, spoke of an indwelling God of mercy who could help men be ethically heroic, and he envisioned a perfectionist utopia. Benjamin Franklin pioneered a third stream of deistic thought; he believed in a God of providential care who should be worshipped by service to men.

In the half century after 1776, the liberal stream was advanced by deistic writers like Thomas Paine, who preached a "religion of humanity." His faith lay in the area where Quakerism and deism overlapped, and his most

famous work exalted reason over Biblical revelation. Thomas Jefferson approached a Unitarianism which paralleled Paine's deism; this faith motivated his support of religious freedom, education, and the optimistic egalitarianism of the Declaration of Independence. Poet Philip Freneau, though trying to advance deism, was doubtful about evil in Nature and men, and much concerned with transience and death; yet his metaphysical tension contributed to his success as artist.

On the conservative side, there was greater religious variety. Alexander Hamilton, cynically using religion, did not become a Christian till an enigmatic death-bed confirmation. On questions of God's mercy and revelation, John Adams stood with his Jeffersonian opponents; but he carried on his Puritan forefathers' certainty about man's sinfulness and, precisely because he saw depravity in the high as well as the low, advocated the checks-and-balance system in government. Most significant figure in the tradition of Edwards was his grandson, Timothy Dwight. This theologian and poet preached a sovereign, Trinitarian God, the depravity of man, and the truth of Biblical revelation; fought "infidelity," and advanced Federalist conservatism. However, with the "New Divinity" he softened the old New England Calvinism.

This study has revealed the individual differences of similar thinkers but also demonstrated a remarkable agreement among antithetical writers—e.g., in their empiricism, their trust in Providence, their concern with religious convictions, and their devotion to Christianity, which they variously defined. Yet the writers can be divided into two major streams of thought—conservative and liberal, or orthodox and sectarian. Those in the first emphasize the sovereignty of God, the sinfulness of man, and their relationship through Christ according to Biblical revelation; those in the second underscore God's mercy and man's potential for good. Some of the more independent writers must be classified in a third channel or in tributaries of the main streams.

A knowledge of these currents reduces parochialism in the understanding of religion in our culture, and increases understanding of American literature, both past and present. Micorfilm \$12.65; Xerox \$45.05. 1001 pages.

THE ACT OF SOVEREIGNTY IN THE AGE OF DISCOVERY

(L. C. Card No. Mic 59-2942)

Manuel Servin, Ph.D. University of Southern California, 1959

Chairman: Professor Cutter

The Portuguese navigators of the early fifteenth century ushered in the Age of Discovery, which culminated with Columbus' finding of the New World. Discovery both in Africa and in America was accompanied by possession-taking activities by which the intrepid European navigators and explorers sought to acquire juridical ownership of terra nullius for their respective nations. Each of the exploring nations established a method, complete with symbolism, and also a rationale for their possession-taking acts.

These symbolic acts of sovereignty, which began with the Portuguese and were continued by the Spanish, English, French, Dutch, Swedish, and the Russians, had their legal and symbolic foundation upon the Germanic and Roman Law of medieval Europe. Although each nation varied the ceremony of symbolic acts of possession in claiming its discoveries, the early colonial powers agreed—at least at the beginning of their colonizing endeavors—that such acts of possession created sovereignty over newly discovered lands. Thus, these nations, including Spain, relied, not upon the decrees of the Papacy, but upon the traditional legal concepts of Western Europe for acquiring sovereignty of terra nullius.

Despite acceptance by the colonial powers of the act of sovereignty as the legal means of obtaining newly discovered territory, international controversies soon developed primarily because the acts performed failed to delimit territory claimed. Thus, rival claims for the same areas soon arose and bitter disputes originated in the sixteenth and seventeenth centuries between Spain and France for Florida, England and Holland for New England and New York, and France and England for the Hudson Bay area. Although Spain and England, who maintained their rights successfully in these disputes, upheld the validity of acts of sovereignty, both France and Holland rejected them and attempted to substitute effective occupation.

Effectiveness of acts of sovereignty was seriously weakened after France's rejection in the Hudson Bay controversy, yet the ceremony of possession-taking did not totally lose international recognition during the eighteenth century. In the Anglo-French rivalry for the Ohio River Valley, France reversed her position and unsuccessfully tried to maintain her title to the territory by a repetitious performance of symbolic acts. England and Spain became embroiled in two controversies, Falkland Islands and Nootka Sound, in which the ceremony of possession-taking played a major role. In both disputes England did not deny completely the validity of these acts, for she based her right to the Falklands on Captain John Byron's symbolic ceremony, and she recognized Spain's right to cosettle and trade on the Pacific Northwest Coast of North America.

The importance of possession-taking diminished greatly in the nineteenth century. The Oregon Question, with early dispute resting mainly on performance of symbolic acts, was settled by effective occupation. Australia and New Zealand were likewise settled as previous acts were ignored.

Yet the acquisition of territory by symbolic acts did not die as the Pacific islands were later effectively acquired by England, France, Germany, and the United States by performance of possessory acts whose effectiveness was supported by the naval and military power of these nations. By the beginning of the 1900's symbolic acts again became of great international significance as the Antarctic continent was claimed by Britain, Australia, New Zealand, France, and Norway as the result of symbolic acts. The denial of the British claims by Argentina and Chile and the impending clash over terra nullius in outer space bring currency to the study of symbolic acts of sovereignty and their repercussions, so that perhaps established precedents can be determined and accepted of the acquisition of terra nullius in the coming Age of Discovery in Outer Space. Microfilm \$4.50; Xerox \$15.75. 350 pages.

HISTORY, ARCHAEOLOGY

A STUDY OF THE STYLE OF THE CUP PAINTER ONESIMOS

(L. C. Card No. Mic 59-6987)

Ann H. Ashmead, Ph.D. Bryn Mawr College, 1959

This study of the vases attributed to the Greek kylix painter Onesimos was undertaken to analyse his style and its development. Further, to review the attributed cups in order to determine which may be securely regarded as by his hand, which new vases should be added to his list, and which pieces removed. Lastly, this thesis attempts to determine the relationship of Onesimos to other artists, and in particular to the Panaitios Painter.

The vases considered fall into three groups dating from ca. 495 B.C. to 480 B.C.

The mood of the early cups is quiet, the drawing is full of mistakes, compositions are more archaic and less organized, the figure scale is often incorrect, foreshortening is less drastic. Human heads are drawn flat-backed, chins pointed, ears narrow. The love-name is Erothemis. This small group contains the only extant signed kylix, Louvre G 105.

Other early pieces are: the Robinson collection fragment; Florence PD 265; Vienna Univ. inv. 501; Leipsic T 3374; and slightly later, Erlangen, Preyss Coll. no. 20.

Group II is much larger, compositions are more balanced, the mood is livelier, the drawing better, figures are taller, heads are larger, ears different. The horses are thinner-bodied with more relaxed interior detail.

The second group contains the four Bryn Mawr fragments (P 986, P 246, P 931, P 935), considered to be from one cup; Heidelberg 63 and Oxford 1927. 4608; Louvre G 291 and Louvre 10.895 are regarded as a pair; Cab. des Méd. (de Ridder 604), Florence PD 382, and the Louvre fragment of a boxer are related to this pair. Munich 2639 is placed contemporary with Louvre 10.895. Louvre S 1324

plus Cp 204, (a girl with a pitcher), is close to the Panaitios Painter's Louvre cup of a reveller (ARV 215, 25 bis). Three athletic cups, Louvre 10.893, Conservatori B-475, (ARV, Manner of Onesimos no. 12) and Petit Palais 325 belong next. Two large cups follow: Bonn inv. 1227 and Perugia 89. The latter is analysed as a pastiche of ideas borrowed from the Brygos Painter. Munich 2637 is assigned to Onesimos and its close relationship to Perugia 89 discussed. Heidelberg 53 follows. Florence inv. 491, the last cup, is the harbinger of the third group.

The mood of the late cups in Group III is introspective. The tondo compositions are beautifully balanced, the exteriors less so. The designs are graceful, refined, the drawing skillfull. The figures are enervated; the men grow taller, their shoulders wider, hips narrower, some are almost ugly. Horse bodies take on a triangular shape.

Here belong Heidelberg no. 62, along with the Watkins Coll. cup; Frankfort L 108; Cab. des Méd. 667 and 694; Cervetri 374; Rome, Museo Artistico cup; Boston 95.29. Spina T 196 is assigned to Onesimos. With it go Oxford G 133, 3, 5, 11, and the Schweitzer hoplitodromos cup, both of which are stylistically close to Villa Giulia 18558 of the Panaitios Painter. Louvre G 296 is considered Onesiman and belongs next to Boston 10.205. Boston 10.211, Brussels A 889 and Vienna 1848 complete the series.

In general Onesimos' strokes are firm and heavy. His figures tend to look undernourished; he prefers to draw the male body, and that nude or with a backdrop of cloth. His drapery is heavy, limp and unelaborate. His favorite medallion border is the interlocking maeander, his favorite topics are athletes and horses.

Heidelberg fragments nos. 53 and 54 are given to Onesimos from the Panaitios Painter.

Cab. des Méd. frr. 665 and 517; Cab. des Méd. no. 658; Cab. des Méd. de Ridder 520; Adria B 611; Bowdoin 23.18; Agora no. 52; Leningrad 656, are considered not Onesiman.

Berlin 30894 is located in the Manner of the Foundry Painter.

The important question of whether Onesimos is also the name of the Panaitios Painter produced the answer that in so far as style, design, subject matter and even in the basic factor of internal development, these two artists are extraordinarily alike. But one difficulty stands in the way before equating them, namely the problem that no correlation proved possible between the early group of Onesimos vases, particularly Louvre G 105, and the early cups of the Panaitios Painter. If this single difficulty could be removed, then the two artists are one. If not, it is suggested that the following cups: Villa Giulia 18558, Louvre G 287, Leningrad 651 and Boston 95.29, now attributed to the Panaitios Painter, not be separated from Boston 10.211 and the two hoplito-dromoi cups of Onesimos, but be given to one artist or the other.

It is hoped that further research will produce evidence to solve this one difficulty.

Microfilm \$7.15; Xerox \$25.45. 562 pages.

"TEŠUP" FIGURINES AND ANATOLIAN ART OF THE SECOND MILLENNIUM B.C.

(L. C. Card No. Mic 60-554)

Jeanny Esther Vorys, Ph.D. Bryn Mawr College, 1959

The bronze figurines which were made in the ancient Near East will be able to serve as primary evidence in major issues if adequately classified. Adequate classification means exhaustive studies of individual groups. One such group is considered here. It consists of seven figurines which, it is believed, represent an Anatolian group of the much larger category of 'Tešup' figurines.

In Chapter I the figurines from Boğazköy and Latakiyeh are described and characterized. Through an examination of their relationship to the art of the Hittite Empire, it is concluded that they were made by a craftsman trained in Anatolian art of this period.

In Chapter II, the figurine from Dövlek is described and compared to the Imperial Hittite bronzes. This suggests that the figurine belongs to an earlier period of Anatolian art. The figurine is then compared to a series of objects to which it is related stylistically, with the conclusion that the figurine is a product of an integrated phase of Anatolian art.

In Chapter III an attempt is made to date the Dövlek phase of art. This is to be done by an analysis of the chronological relationship of the objects of the Dövlek phase to those in the well known sequence of Anatolian Art. A detailed examination of the non-stylistic elements on the Tyszkiewicz seal suggests a date at least as late as the Late Colony period. An analysis of the stylistic features of the Dövlek group leads to the conclusion that the Dövlek phase must be dated shortly after the Late colony period.

In Chapter IV a silver figurine from Nezero, Thessaly is discussed. A comparison to the bronzes discussed in Chapter I and II suggests that it should be dated between the Dövlek and the Imperial Hittite bronzes. A knob cylinder seal in the Louvre furnishes an indication that the figurine is part of an integrated phase of Anatolian art. The stylistic development implied by the figurines is substantiated by the seals of either phase. The correctness of the sequence of phases is checked by an analysis of the relative date of non-stylistic elements on the seals.

In Chapter V an attempt is made to classify three bronzes within the framework suggested in Chapter I - IV. The first (Bibliothèque Nationale 900) is found to be a provincial product of the Dövlek phase. The second (a figurine from the Konya region) is thought to be a product of a very remote area during the Nezero phase. The third (Hilprecht Collection in Philadelphia) is thought to be a product of a northern provincial school in the Imperial Hittite period.

In Chapter VI the bearing of the Anatolian group of Tešups on some general issues is suggested. Their importance in the understanding of the development of Anatolian art is considered. The clear distinction between the Anatolian group and its Syrian counterparts leads to the suggestion that Anatolia may have exerted considerable influence on Syrian art in the second millennium. The isolation of the Anatolian group also demonstrates that two bronzes found in the Aegean area (at Tiryns and Lindos) must have come from Anatolia.

Microfilm \$2.50; Xerox \$8.20. 178 pages.

HISTORY, MEDIEVAL

THE NORMAN THEORY OF THE ORIGIN OF THE RUSSIAN STATE: A CRITICAL ANALYSIS.

(L. C. Card No. Mic 60-1372)

Alexander Valentinovich Riasanovsky, Ph.D. Stanford University, 1960

One of the oldest controversies in Russian historical literature has revolved around the problem of the origin of the Russian state and Russian culture. Two schools of thought have emerged out of this controversy: the Normanist and the Antinormanist. The Normanists have attempted to explain the appearance of the first Russian state as a result of the activity of the Scandinavians-Normans. The Antinormanists have resisted what has seemed to them a "Germanic" explanation of Russian national beginnings and have offered a number of alternate theories.

The dissertation traces the development of the Norman theory from the first half of the eighteenth century to the present, and examines the main arguments advanced by Normanists in the light both of Antinormanist criticism and of the latest historical, philological and archeological findings. The study is based upon the evidence of medieval Russian and Western European chronicles, of Persian, Arabic and Byzantine documents, as well as upon the voluminous literature written on the subject in the last two hundred years.

Part I of the dissertation examines the Normanist contention that the term Varangians (variazi) used in the Russian chronicles was of Scandinavian derivation and referred exclusively to Scandinavians-Normans. Part II analyzes the Normanist attempts to prove that the name Rus' (the Russian national name) was of Scandinavian origin and was brought to Ancient Russia by Scandinavians-Normans. Part III discusses the Normanist interpretation of Western European, Byzantine, Persian, Arabic and other medieval documentary sources. Part III also examines Normanist claims that Scandinavian travellers helped spread Byzantine culture among the Russian Slavs and that the names of early Russian princes were of Scandinavian derivation.

The study points to the failure of Normanist scholars to establish a firm connection between the Varangians mentioned in Russian chronicles and the Scandinavians-Normans. Far from being the exclusive designation for Scandinavians-Normans, the term Varangians was used in the Russian chronicles to mean Baltic Slavs (primary use) and Western European soldiers and merchants. In Byzantine literature, the term referred to European mercenaries of various nationalities. Analysis of attempts by Normanist philologists to prove that the term Rus' was of Scandinavian origin reveals similar lack of success; neither have Normanists been able to explain the fact that Rus' appeared in southern Russia as a national name long before the advent of the Varangian princes in the ninth century. Various theories advanced by Normanists to account for the early appearance of Rus' in southern Russia find no support in documentary evidence and archeological data. The testimony of medieval sources, likewise, fails to identify the Rus' with the Scandinavians-Normans. In fact, these sources indicate that the Rus' were Russian Slavs and that a Slavonic state existed in southern Russia several centuries before the coming of the Varangians. Further examination of sources also reveals that Scandinavian travellers to Constantinople who returned through Russia were too few to account for the wide influence exerted by Byzantine Greeks upon Russian civilization. Finally, it is pointed out that the names of early Russian princes can be explained on the basis of Slavonic and other European languages as well as, and frequently better than, on the basis of Scandinavian.

For over two centuries, Normanist scholars have tried to prove that Scandinavians-Normans founded the first Russian state and acted as mid-wives at the birth of Russian civilization. It is hoped that the present study will serve the useful purpose of dispelling some old misconceptions so that a fresh look may be taken at the problem of Russia's national origin.

Microfilm \$3.40; Xerox \$11.95. 262 pages.

THE SENECAN NOTION OF OBLIGATION AND ITS INFLUENCE ON TERTULLIAN'S PRESCRIPTION OF HERESY

(L. C. Card No. Mic 60-1342)

Bernard F. Scherer, Ph.D. University of Pittsburgh, 1959

It is the problem of showing the worthiness of one office or institution over another with which this study is concerned.

The most complete and analytical attempts for arriving at a formula for the most successful institution or state began in the Hellenic world with Plato's Republic and continued with Aristotle's Politics. With the decline of Hellenic Greece, however, the notions of both Plato and Aristotle came to be looked upon by the Hellenistic society as not only heavily colored by Hellenic experience but also as idealized, with little regard to reality.

Hellenistic man desired a broader approach to government than that of the Hellenes before him. It was the Stoics who gave to Hellenistic man this broader approach, this idea of "citizen of the world." It was the Stoics who recognized that law and governance, in order to be effective, must consider the widest concerns of man. Further, the Stoic posited, only those laws performing such a broad office were good laws.

Specifically, it was Zeno, acknowledged as the founder of Stoicism, who first drew the attention of Hellenistic man to the benefit of this broad principle of law and to the merits of obligation to that law.

At Rome Stoicism acquired a distinctly legal coloration. Cicero, the lawyer, plainly stated that law, to be imposing, had to deal equally with each individual and because it did so, equally bound each individual. Subsequently, Seneca, who dwelt at length on the origin of all laws and all benefits, namely the gods, argued that the gifts or benefits bestowed by the gods consequently obligated man.

It was at this point that the Western Church Father, Tertullian, seized upon the Stoic approach, especially that of Seneca, to show that the Apostolic Church constituted a benefit bestowed by Christ. Tertullian argued that by the Redemption man was set free; he further charged that the law or rule of Christ, like any universal law, was to be obeyed by all men.

Tertullian further labeled as heretics those who sought

to differ with the Christ-founded Apostolic Church, those who denied the obligation and obedience required of them. Because of this, Tertullian argued, the heretic forfeited any orthodox standing in Christianity.

The profound influence of this Tertullianist stand established two alternative dogmatic courses for those to follow, especially those in the Middle Ages: Man could either lean towards the discomforts of an authority without intelligibility or he could sacrifice such authority, without which intelligibility was difficult to come by.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

HISTORY, MODERN

THE LOUISIANA WHIG PARTY

(L. C. Card No. Mic 60-1459)

William Harrison Adams III, Ph.D. Louisiana State University, 1960

Supervisor: Professor T. Harry Williams

The Louisiana Whig party was an integral part of the national party which evolved from the National Republican party in 1834. Like its predecessor the Whig party advocated the protective tariff, the bank of the United States, and internal improvements at federal expense. Louisiana sugar planters needed tariff protection for their industry; the low-lying geographic condition made water control and other improvements a necessity; and New Orleans' leadership in trade and commerce made banking and money critical issues. Jacksonian opposition to these programs led to the Whig cry of executive usurpation. The Whig party controlled Louisiana government until 1842 when the Democratic party first gained control of the governor's office, which it retained until Reconstruction. The Whigs had grown weak because of the lingering depression started by the Panic of 1837, which included numerous New Orleans bank failures, and the suspension of specie payment; the increased number of small farmers in north and southwest Louisiana who were always Jacksonian Democrats; and the defection of John Tyler.

Henry Clay played an important role in the Louisiana Whig party, but he was unable to receive a majority of Louisiana's popular votes when he sought the presidency. William Henry Harrison and Zachary Taylor, the only elected Whig presidents, were able to carry the state's electoral votes.

In 1845 the Democrats changed the Constitution of 1812 in order to broaden the electoral franchise, make more government officials elective officers, and prevent direct aid by the state to corporations. The new constitution further strengthened the Democratic party, yet, until 1852 the Whigs frequently elected majorities to the state legislature, and to send party members to Congress.

The election of Zachary Taylor led to renewed hopes among Louisiana's Whigs, but he soon disappointed them. The Compromise of 1850 served to dramatize the sectional split within the national party that threatened its existence. In the state the Whig party favored preservation of the

Union, but it was unwilling to join a Union party movement started in Georgia.

As a last effort to regain power the Louisiana Whigs championed successfully a new constitution in 1852. With aid from the Democrats they wrote provisions that permitted aid by the state to corporations, particularly railroad companies and banks; provided for an elective judiciary; and the total population basis for legislative apportionment. When the new constitution was accepted by the voters the Whigs were split into country and city factions by the new basis of apportionment. The Whigs were further weakened by the national sectional strife; and particularly were the Louisiana Whigs disappointed by the presidential nomination of Winfield Scott in preference to Millard Fillmore. After the election of 1852 the Whig party in Louisiana collapsed. Many Whigs drifted into the Know Nothing Party, and others joined the Democrats.

At all times the Whigs offered a more positive political program than did their opponents. Whig economic philosophy seemed much more stable than the uncertainty of the Democrats. By 1852 the state's Democrats apparently adopted Whig policies as their own. Since leaders in both parties were seemingly equal in wealth and education, it is difficult to accept the belief that the Whig party in Louisiana was a class party.

Microfilm \$4.85; Xerox \$17.10. 379 pages.

LUTHER ACADEMY, 1883 TO 1903; A FACET OF SWEDISH PIONEER LIFE IN NEBRASKA.

(L. C. Card No. Mic 59-3777)

James Iverne Dowie, Ph.D. University of Minnesota, 1957

This dissertation examines the religious and cultural context out of which Luther Academy at Wahoo, Nebraska, arose. It seeks to trace the motivation and resulting pattern of Swedish settlement in Nebraska, to survey in a cursory way the church polity of the Evangelical Lutheran Augustana Synod, and to present biographical notes on those church leaders who had a direct influence upon the settlements or the school. The Rev. S. G. Larson who was the first Augustana Lutheran pastor to serve the Swedes of Nebraska and the Rev. J. Torell who was a devoted worker in the same field made indispensable contributions to the story of Luther, while S. M. Hill, a lay educator, provided early direction and continuous leadership for the school.

Much of the present state of Nebraska falls within the region once designated on many maps as the Great American Desert. After the state entered the Union it became the business of many promoters to dispel the desert myth and to create in its stead the myth of the garden. Land agents like O. F. Davis of the Union Pacific, politicians like R. W. Furnas, and preachers like S. G. Larson were intent upon urging settlers to choose Nebraska for their new homes.

Population growth in Nebraska from 1870 to 1890 suggests the effectiveness of these collective efforts to lure prospective settlers into the state. Since Luther Academy was a product of Swedish migration, the statistics of Swedish settlement are a part of its history. In 1870 there were fewer than 2,500 Swedes in Nebraska, but by 1890 the

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number had risen to more than 28,000. Homogeneous communities of Swedish settlers had grown up in various parts of the state. Mead, Swedeburg, Malmo, Swede Home, Stromsburg, and Wahoo were samples of communities where the Swedish element was strong.

As the Swedish settlements increased, the leaders of the Augustana Lutheran Church nurtured a sensitive conscience on their behalf. Missionary pastors like S. G. Larson and J. Torell came to Nebraska and built churches founded in the Lutheran creed. Larson reached Omaha in 1868. Recognizing the tie between the solidly Swedish settlement and a strong Lutheran church, Larson spent the next ten years encouraging other Swedes to come to Nebraska through his letters and articles in the Swedish language press. His major efforts were expended upon the settlements in Saunders County. Larson was credited with establishing six Lutheran congregations in Nebraska.

John Torell was equally diligent as a missionary pastor to the Swedes in Nebraska. He and other Lutheran pastors took the initial steps in founding Luther Academy. These churchmen looked upon a church school as indispensable to the Swedes in preserving their cultural and church ties. With the cooperation of laymen Luther was organized in 1883.

The constituency which supported Luther Academy was never prosperous. Frequently the financial resources of the school were inadequate; however, articulate leaders like Torell and Hill kept Luther open during times of economic crisis.

If the dissemination of the gospel and the preparation for a better life through acquisition of knowledge represented the true purposes of Luther, statistics may suggest to what extent the school fulfilled its destiny. During fifty years, 1883 to 1933, eighty-five Luther students entered the ministry, and three hundred twelve became teachers. Students have gone forth from its classrooms into many walks of life. The Swedish pioneers planted, sometimes in sacrifice and poverty, the seed. The harvest, small in comparison with great institutions of learning, has not been insignificant to the Swedes in Nebraska and to the Augustana Lutheran Church in its general missionary program. Microfilm \$4.90; Xerox \$17.35. 384 pages.

THE FINANCIAL ROLE OF INDIANA IN WORLD WAR II

(L. C. Card No. Mic 60-821)

Bernard Friedman, Ph.D. Indiana University, 1959

Indiana's financial role in the Second World War was neither exceptional or novel. Hoosiers, as was the case with all Americans, paid taxes at unprecedented rates, loaned money to the federal government in unprecedented amounts and submitted to an unprecedented regime of economic controls. Dealing with a single state such as Indiana does afford the viewer, however, a more intimate picture of the forces that shaped fiscal and stabilization policy as well as a deeper appreciation of the impact of war finance as it bore down upon the mass of Americans.

In Indiana, at least, the debate over fiscal policy was simply an extension of the arguments over federal fiscal

affairs that had exercised public opinion during the depression decade. Critics of the administration, once convinced of the urgency of armaments expenditures, advocated a reduction in non-defense expenditures -- "New Deal" expenditures -- and the adoption of a general sales tax as the most satisfactory means of raising additional revenue and at the same time checking inflation. Organized labor in the state vehemently countered this program by demanding more steeply graduated individual and corporate income and excess profits taxes and by supporting non-fiscal economic controls as a check on inflation. Sensitive to such crosscurrents of opinion, Congress expanded the income tax base, advanced rates steeply, adopted an excess profits tax, but failed to adopt an annual salary limit of \$25,000 or a general sales tax. In this way, then, did the clash of interests in Indiana contribute to Congressional inhibitions.

A similiar division of Hoosier sentiment made itself felt in the molding of stabilization policy and affected as well the functioning of price controls and rationing in the state. Hoosier conservatism viewed price controls as a subtle form of expropriation, was especially incensed over price roll-backs and agricultural subsidies (instituted by the administration in mid-1943), and favored absolute ceilings on wages as a means of holding down production costs. Liberal opinion in the state, spearheaded by the unions, advocated more stringent price controls, applauded roll-backs and supported subsidies to food producers. The enforcement of price controls and rationing regulations in Indiana suffered from the bitterness with which the fight over policy was waged. The Office of Price Administration was fair game to administration foes. Blackmarketeering, both petty and grand, was encouraged by a hostile climate of opinion engendered by the poor press from which the OPA suffered continually. Nevertheless, it is still possible to conclude that most Hoosiers did abide with rationing regulations and price controls -- most of the time.

It was only in the government's lending program that there was almost complete unanimity among Hoosiers, a fact which accounts for the notable success of the Indiana War Finance Committee in guiding the state through eight great war loan drives. This unanimity was especially apparent in the growth of the payroll savings plan in Indiana. With both management and labor pulling together, nine out of every ten Hoosier wage earners were eventually enrolled in the plan. Here was perhaps the major achievement of war finance in Indiana and the nation.

Microfilm \$4.75; Xerox \$16.90. 371 pages.

THE UNIVERSITY OF EDINBURGH, 1660-1715: A STUDY IN THE TRANSFORMATION OF TEACHING METHODS AND CURRICULUM.

(L. C. Card No. Mic 59-6989)

Isabel Kenrick, Ph.D. Bryn Mawr College, 1957

This study analyzes the transformation which the College of Edinburgh underwent between 1660 and 1715. It is focussed specifically on developments in curriculum, pedagogical method and educational goals, on their relationships to events in contemporary Scottish life and to concurrent developments in Continental thought. Its purpose

is to describe more precisely some of the formative elements in the creation of the eighteenth century Scottish Renaissance.

In 1660 the college curriculum consisted in commentaries on Aristotle and controversial theological works. This material was dictated in latin by four regents, each of whom took one class throughout its four year course. There was little reading of texts, and examinations were by formal medieval disputation. Some non-Aristotelian material was offered outside this regular course. Most students prepared for the ministry.

By 1715 the university offered a variety of subjects, ancient and modern. The teaching was divided among specialized professors. There was freedom of choice within the curriculum, lecturing in the modern sense, outside reading, experimental studies and some teaching in the vernacular. The aim of this education included training for middle-class professions and, for the man of affairs, general grounding in philosophy, letters and current thought.

The factors in this transformation discussed in the dissertation are the religious basis of Scottish education, its close connection with Dutch universities, the dependent relationship of the college to the Edinburgh Town Council, and the reaction of individual Principals and teachers to the wider currents of European thought.

The seventeenth century Presbyterian-Episcopalian conflicts obscure the consequences of the fundamental Scottish agreement on Reformed religion. The Calvinist emphasis on religion as theology had its counterpart in the philosophical and systematic approach of Scottish university education which persisted after its specifically religious content was lost. The process of secularization was actually furthered by both religious and non-religious factors - disgust with religious wrangling, emergence of other criteria such as utility, scientific truth, reformation of manners. Education became concerned with practical questions of the immediate world, as shown by the decay in the vitality of theological studies in contrast to expansion in other fields, and by the attitudes of scientists and scholars to religion.

Many Scottish students attended Continental, particularly Dutch universities. Over 750 Scottish names are inscribed in the Leyden University Album between 1660 and 1715. Foreign study exposed students to the new ideas of Gassendi, Descartes, Puffendorf, and to the influence of individual professors. Many changes in Edinburgh were implicitly or explicitly patterned on practices in Holland, particularly after 1688. Principal Carstairs attempted to attract Dutch professors and the 1708 curriculum reforms were consciously modeled on the Dutch system.

The college, controlled by the Edinburgh Town Council, was not an independent, privileged corporation. This fact frustrated the recommendations of outside investigating commissions. But it meant that in the end the college could not resist pressure by prominent Edinburgh citizens, e.g. for the establishment of a botanical garden, for medical and legal studies. The Town Council records show the progression of educational ventures, first licensed outside the college, and eventually incorporated into its regular curriculum, e.g. languages, botany, law, chemistry. This kept the distinction between academic and non-academic subjects fluid, affecting the professional, practical aspect of Edinburgh University education.

This transformation expressed the translation of the Reformed religious tradition into modern educational

terms, the successful adaptation of Dutch methods, text-books, and educational ideals, and the demands of the practical minded patrons of the college. The result was a unique experiment which combined professional training for middle-class occupations with thorough grounding in philosophical studies. It was this university climate which made possible the eighteenth century Scottish Renaissance.

Microfilm \$2.50; Xerox \$7.40. 157 pages.

REPORTING BY ACCREDITED NEWSPAPER CORRESPONDENTS OF ARMY CAMPAIGNS AGAINST HOSTILE INDIANS IN THE AMERICAN WEST, 1866-1891.

[Please Note: To obtain copies of this thesis, Library of Congress No. 60-8751, please write directly to the University of Oklahoma Press, Norman, Oklahoma.]

Oliver Holmes Knight, Jr., Ph.D. The University of Wisconsin, 1959

Supervisor: Professor Vernon Carstensen

A determination of the nature of newspaper reports from Army campaigns against hostile Indians in the American West would have implications for both the history of the West and the history of journalism. Previous research has shown the development of war correspondence in the Mexican, Crimean and Civil wars. An unknown element has been the work of accredited newspaper correspondents during hostilities with American Indians.

The study was confined to the period 1866-1891, because that period contains elements of homogeneity that make possible the identification of the hostilities as the Western War, consisting of several campaigns against various tribes in the trans-Mississippi West, and because the period succeeded the Civil War in which American newspapers became accustomed to war reporting as a regular function. The study was confined, also, to accredited newspaper correspondents, as distinct from occasional and non-professional correspondents. The basic research approach was to collect the full text of newspaper dispatches and subject them to analysis through comparison with official reports. Supplemental comparison was obtained through memoirs and other writings of Army personnel who participated in the campaigns. Dispatches and other evidence were examined to determine general content of the dispatches, the status of the correspondent, his methods, his experiences, and his qualifications.

The results showed 19 identifiable accredited correspondents reported the major campaigns from 1867, when the first staff correspondent went into the field, to 1881, after which field operations diminished almost to the vanishing point. Most of their work was done during years which are included in the period of the Independent Press. Their war reporting generally was found to be a faithful account of military operations, they held privileged status as members of the expeditions, they reflected the Army viewpoint on Indian affairs, they were required to fight when occasion demanded, they almost invariably included geographic description in thier dispatches, and most were qualified newspapermen. Their subsequent careers indicate most were men of personal substance.

Twenty-one other correspondents assembled for the Sioux disturbance in South Dakota in 1890-1891, during the period of the New Journalism. They have been accused of distortion and falsification. Thus, the results also demonstrate the contrast in reporting between the periods of the Independent Press and New Journalism.

THE CITY MOVES WEST: ECONOMIC AND INDUSTRIAL GROWTH OF THE SOUTHERN LLANO ESTACADO.

(L. C. Card No. Mic 59-5495)

Robert Leslie Martin, Ph.D. The University of Oklahoma, 1959

Major Professor: Dr. Gilbert C. Fite

The purpose of this study was to examine the factors involved in the growth of small cities in a restricted area of West Texas.

Only towns having a population of at least 10,000 at the time of the 1950 census were considered. Six such municipalities existed, and between 1900 and 1958 their total population grew from less than 2,000 to more than 200,000. The factors that caused this development were location, ranching, farming, and oil production.

Between the time the first immigrants arrived in the late 1870's and about 1900, ranching was the only industry in West Texas. Cattlemen who were on the scene and consequently were able to take advantage of cheap land made great profits. It was during this period that the first towns began to develop. Two criteria determined their location, water and transportation facilities. Springs and streams provided the first need, and the arrival of the Texas and Pacific Railroad in 1881 and 1882 the second.

Commercial farming began about 1900 and 1930 had surpassed ranching as the most important industry in the area. At the latter date the towns were small rural communities supplying the needs of a slowly growing population. During this period the years between 1900 and 1915 were those of greatest growth, and people on the scene realized the greatest returns from their investments.

The first commercial oil discovery made in West Texas was in 1920, but not until 1925 and 1926 were important oil deposits found. The period of greatest growth of the towns was between 1940 and 1958 when oil activity dominated the economic picture in the area. Some industry also began during these years, but most of it was connected with oil in some way. By 1958 petroleum production was the most important factor in the economy of all the towns with the possible exception of one, and at least two of the communities were completely dependent on the oil industry.

The future of this area, and of its continued growth, depends on two factors, how long oil will continue to be produced, and whether adequate water supplies can be found for a growing population.

Microfilm \$3.40; Xerox \$11.60. 262 pages.

A HISTORY OF THE LUMBER INDUSTRY IN ALABAMA AND WEST FLORIDA, 1880-1914.

(L. C. Card No. Mic 60-1389)

Richard Walter Massey, Jr., Ph.D. Vanderbilt University, 1960

Supervisor: Professor Herbert Weaver

Although the lumber industry was one of the first major industries to develop in the South after the end of Reconstruction, very little of an historical nature has been written about the subject. Lumber operations in certain comparatively small areas within the South have been examined, and future research of more such areas should facilitate the completion of a comprehensive history of the lumber industry in the South. This thesis examines the industry during the years 1880-1914 in the area south of the fall line in Alabama and west of the Apalachicola River in Florida. This area offers a fair sample of lumbering operations of various types, and as an examination of the characteristics of the forests shows, it was correctly considered a homogeneous unit by lumbermen.

One of the most interesting phases of the lumber business was the methods used in acquiring the timberlands. At the end of the Civil War most of the forest lands in the South were publicly owned. By the beginning of World War I the majority of this land had passed into private hands with decidedly mixed results as far as the public was concerned.

Logging operations in the forest, with the subsequent transporting of the logs to the mills, required a tremendous amount of hard work and ingenuity. Much experimentation resulted in efficient operations and set a pattern that was to last for many years. Various means of water transportation were used, but the greatest advances were made in land transportation. The topography of the region favored the construction of logging railroads, and by 1914 some of the most extensive privately owned railroads in the country were being operated by the lumber companies. During this period the logging railroads developed from the crudest type of pole road, using work animals for motive power, to well constructed and graded roads using steel rails and special steam locomotives.

In addition to the superb forests and level topography, an abundant supply of competent workers was available within the region. The picturesque lumberjack of the north woods was not found in the lumber camps of the South, but in his place were Negro and white farmers who were accustomed to working long hours out of doors. These workers were often only semi-literate, but they readily learned the necessary skills and seldom worried the owners by organizing into unions or making "unreasonable" demands. A study of the wages, working conditions, company stores, social life, and paternalistic attitude of the employers gives a picture of a way of life that was common to many people before World War I.

The manufacturing of lumber does not have to be as costly and as complex an operation as many manufacturing processes. Because of this, it was possible for lumber manufacturing plants to vary from the crude type used by farmers for local consumption to the costly, large-scale modern plants that by 1914 were cutting as much as one million board feet of lumber daily. The various methods of manufacturing and the evolution of these methods are examined in some detail.

The development of efficient business methods was almost as important to the lumber industry as the advance in technology. The lack of entrepreneurial skill was the cause of many bankruptcies and it was not until business methods improved that the industry in the South took on the characteristics of a stable and profitable enterprise.

The lumber industry had a decided impact on the economy of the region. It attracted large amounts of capital with the result that job opportunities, cash wages, tax revenues, and local trade showed definite improvement.

Microfilm \$3.05; Xerox \$10.60. 233 pages.

THE DEVELOPMENT OF MICHIGAN'S OIL INDUSTRY: 1860-1935

(L. C. Card No. Mic 60-1303)

Darrell Henry Pollard, Ph.D. University of Michigan, 1959

Although generally overlooked by Michigan historians, the state's oil industry has been responsible for some of the most interesting pages in Michigan lore. Ten exciting years, from 1925 to 1935, saw the emergence of the state as one of the country's respected oil producers. In the short period of this decade, following a half-century of rather disappointing exploration, oil became recognized as one of the state's most precious resources, and Michigan found itself listed among the United States' producers of petroleum.

There are no comprehensive studies of the history of Michigan's oil industry. Consequently, regional newspapers covering daily oil field activity provided the most illuminating sources of up-to-date information. Trade journals, also, are filled with accounts of prospecting, field conditions, refining, and oil company development.

Historically, Michigan lagged slightly behind Pennsylvania in the discovery of oil. Michigan's recorded oil history originated in the 1860 report of Alexander Winchell, an early state geologist. Both private and governmental interest in exploiting the state's oil potential remained casual until the 1880's, when, after success in neighboring Canadian fields caused oil men to turn to eastern Michigan, Port Huron produced a series of successful oil wells. Building upon this original experience, Michigan's petroleum industry expanded until in 1935 more than 54,728,000 barrels of oil had been produced from local wells, with the yearly production totalling over 15,000,000 barrels.

Between the years 1860 and 1935, the history of Michigan petroleum may be divided into two periods; one ending in 1920, and the other, after approximately five years of inactivity, beginning around 1925. The earlier period can be characterized as one of rather haphazard exploration.

The more spectacular and successful phase of this story began in the second quarter of the twentieth century. Michigan's record of oil production of statewide and national commercial importance began with the discovery of the Saginaw field in 1925. Since that discovery date, the state's oil development fell into two subsequent periods: 1) the Saginaw and Muskegor Booms, 1925-1928, and 2) the Central Michigan Development, 1928-1935.

The year 1935 was a banner year for Michigan's oil industry. According to the United States Bureau of Mines,

Michigan ended the year in seventh place among the eighteen oil producing states in the nation. This position was based on October, November and December production only. The state's industry had grown from a single field producing some 4,000 barrels in 1925 to a point where thirteen fields produced over 15,700,000 barrels of oil a year. In the ten years between 1925 and 1935, approximately 1,820 producing wells had been drilled within the state. These wells had compiled a cumulative production total of over 54,000,000 barrels. In no other state east of the Mississippi had so much oil activity taken place as in Michigan during the period of 1925 to 1935.

Development in Michigan seemed to indicate that the industry would continue for many years. The major formations had nowhere nearly been fully exploited. However, although Michigan had worked itself to the position of eighth in yearly production, it was doubtful that it would ever be among the highest ranking petroleum producers of the nation. Nevertheless, the trend toward deeper drilling made it very probable that Michigan's production rate as of 1935 would continue to sustain itself for many years to come.

Microfilm \$4.50; Xerox \$15.75. 350 pages.

JEANNETTE RANKIN, PROGRESSIVE-ISOLATIONIST.

(L. C. Card No. Mic 59-5221)

Ronald Schaffer, Ph.D. Princeton University, 1959

Summary

Jeannette Rankin (1880 -) was born in and grew up in Montana. In 1908 she joined the reform movement, first as a settlement worker and then as a suffragist. The New York School of Philanthropy taught her progressive doctrines, and while working for the New York City Woman Suffrage Party, she learned how reform politicians operate. From 1910 to 1915 she worked as a lobbyist for the National American Woman Suffrage Association and for local organizations.

In 1914, with the aid of a well-run machine, she led a suffrage victory in Montana. Two years later, the machine nominated her and helped send her to Congress as the first woman ever elected to that office.

Almost immediately, she had to vote on a declaration of war with Germany; with great emotion, she voted against it. For the rest of her term she supported the war effort and devoted herself, mainly, to pushing through the 19th Amendment and to aiding workers, particularly those of her sex.

In 1918 she made an unsuccessful race for the Senate. When her term expired she became a lobbyist again, this time for pro-labor and for anti-war organizations. Beginning in 1930, she served the National Council for Prevention of War as its legislative secretary, pressuring Congressmen, making speeches in various parts of the country, and building a local organization in Georgia to manufacture public opinion against rearmament. During this time she was changing, at least publicly, from an internationalist to an isolationist.

In 1940 she ran for Congress again and won. On December 8, 1941, she cast the sole vote against declaring war on Japan. A year later she became one of the first to

suggest, openly, that the President had conspired to bring about the Pearl Harbor attack.

Jeannette Rankin was a woman of contradictions. She was an internationalist and an isolationist. She believed in reform methods based on facts, and in panaceas like the Townsend plan. She was idealistic and extremely pragmatic. Most ambiguous of all was her attitude toward the people, whom she considered both as a neutral instrument to be manipulated and as a source of reform sentiment for people like herself to tap.

Microfilm \$3.60; Xerox \$16.20. 277 pages.

THE PUBLIC LIFE AND CHARACTER OF JAMES, THIRD MARQUIS AND FIRST DUKE OF HAMILTON, 1628-1644.

(L. C. Card No. Mic 60-1537)

Allan M. Schleich, Ph.D. The University of Nebraska, 1960

Adviser: Glenn W. Gray

The only biography of James, 3rd Marquis and 1st Duke of Hamilton, is that written by Bishop Gilbert Burnet within thirty years of Hamilton's death. Despite the author's bias, Hamilton emerged an enigmatic figure. This study is an effort to give intensive treatment of his career between 1637 and 1643, during the period in which Charles I's Scottish troubles developed into the Civil War in England.

In order to understand Hamilton it has been necessary to sketch the Marquis' earlier background and the background of the Scottish situation. It is believed that the surveys of the Ochiltree affair and the German expedition throw new light on those incidents. This work stops with the natural break of Hamilton's imprisonment in 1643. His later career is the subject for another study which the author hopes to complete in the future.

It is believed that all printed materials have been used. There are very few manuscript collections which are of value to this study. The only important collection not available is the Breadalbane MSS., preserved at the General Register House, Edinburgh. It does not seem possible that these would have seriously altered the picture presented of Hamilton.

Unfortunately, Hamilton remains almost as enigmatic as before. The evidence appears conclusive that he helped to precipitate the troubles in 1637. However, he appears thereafter to have remained basically loyal to Charles in this period. After the adoption of the Covenant and its acceptance by a large segment of the Church and Scottish nobility Hamilton did his best to bring the trouble to an end. During the period which saw the collapse of negotiations between Charles and the Scots and the outbreak of the Bishops' Wars, Hamilton remained the King's principal advisor on Scottish affairs and one of his advisors for English policy. In many cases the advice he gave Charles proved disastrous. In a majority of cases his advice and the action taken were logical at the moment.

At some point after the 2nd Bishops' War Hamilton's desire to serve his King loyally came in conflict with his desire for self-preservation. The bond of personal friend-

ship which existed between the two men may have prevented Hamilton for months from fully realizing the extent to which he had compromised his loyalty. The writer believes that the events of the Incident in October, 1641, indicate Hamilton had turned his back upon Charles and was willing to co-operate with his enemies. The final act of the Marquis before his imprisonment was an attempt to redeem himself in the eyes of the King by a characteristically ineffective attempt to prevent the Scots from entering the war on the side of the English Parliament. After this, Charles, if he were to receive any help from Scotland, had to order Hamilton's arrest.

Microfilm \$4.45; Xerox \$15.55. 345 pages.

POLITICAL HISTORY OF LAND WÜRTTEMBERG 1918-1932

(L. C. Card No. Mic 60-1507)

Charles Francis Sidman Jr., Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Chester V. Easum

An investigation of Weimar Germany affords a striking example of the tragic failure of republicanism in a powerful and restless European people and, hence, is an eminently worthwhile undertaking. That the National Socialist government which supplanted it was born, developed, and waxed strong within the political framework of this Germany adds incentive to such a study. For these and many other reasons, the history of Weimar Germany merits careful attention. This scrutiny of one Land, Württemberg, is but a facet of this history.

Four basic challenges faced Württemberg during its Weimar tenancy: the establishment of democratic procedure; the development of a party system; the attempted resolution of social, economic, and political difficulties within this framework; and the progress of National Socialism in such an environment. These challenges determine the scope of this study.

Through proposals and discussions contained in the minutes (Protokoll) of Württemberg's representative assembly (Landtag), ideas basic to men of different backgrounds and parties found articulate expression. A sampling of newspapers from two major categories—the overt party organ and the "takers of a stand"—gives a genuine feeling for the times and facilitates a proper evaluation regarding the importance of issues as they were considered in those days when the Press furnished most people with their awareness of contemporary affairs.

their awareness of contemporary affairs.

To expedite a consideration of politica

To expedite a consideration of political trends, the progressive development of republican "life" has been traced in this study through the voting results of the five Landtag elections held in Württemberg between 1919 and and 1933 and the significant Reichstag election of 1930. Statistical studies present valid insights into contemporary economic and social conditions. Biographies, autobiographies, and party histories, which either feature or incorporate the substance of Württemberg's history, have substantial merit as secondary source material. General works on Germany's Weimar history emphasize continuity—what transpired in Berlin effected a corresponding reaction

in Stuttgart; to a lesser degree, rumblings in Stuttgart vibrated in Berlin.

Generally, Württemberg's republican government functioned effectively. To the credit of Württembergers, many Land problems were resolved despite enormous difficulties. Ultimately, however, the thrusts of National Socialism weakened and unnerved Württemberg's unsteady republic. To convince the citizens of the Land that the republic was not only incompetent but discredited, the National Socialists converted the Württemberg Landtag into a courtroom for the trial and sentencing of a governmental system of which the Landtag itself was an expression.

Württemberg gave less generously to the support of National Socialism than the Reich as a whole. In no election (Landtag or Reichstag) did the National Socialists receive one-half or more than half of the Württemberg total vote. In only one of the sixty-three counties of the Land (Gerabronn) did they succeed in mustering more than a fifty per cent vote.

Many things prompted Württembergers to vote for the National Socialists. Desperation, inexcusable ignorance, conscious revolution against social convention, lack of a resolute will, want of suitable alternatives, inexperience in the functioning of republican government—these and additional explanations to suit Württemberg's diverse personalities account for the National Socialist march to power in that Land.

Microfilm \$4.85; Xerox \$17.10. 380 pages.

HOME ECONOMICS

THE USE OF GROUP COUNSELING IN THE MODIFICATION OF PARENTAL ATTITUDES CONCERNING THE GUIDANCE OF CHILDREN

(L. C. Card No. Mic 60-1405)

William Thomas Carroll, Ph.D.
The Florida State University, 1960

The purpose of this study was to assess the treatment effects of group counseling with parents of nursery school and kindergarten children.

The major objectives of this study were (a) to test the significance of gains made on the Wiley Child Guidance Survey (short form) in a before-and-after design of testing of parents attending group counseling sessions; (b) to compare the gains of subjects who attended from four to eight group counseling sessions with those who attended no more than three; and (c) to determine whether or not initial scores on the Child Guidance Survey of participants were independent of sex, social class, and number of children in families.

The subjects were 111 parents of three-, four-, and five-year-old children enrolled in preschools. They were self-selected by voluntarily attending group counseling sessions and by completing the initial and final surveys. Thirty-four had children attending nursery school in the university community of Tallahassee, Florida. The remaining two groups had children enrolled in kindergartens in the urban, non-university community of Savannah, Georgia. All three parent groups were predominantly Protestant in religion; socio-economic status in the Tallahassee group ranged from lower-middle through uppermiddle, and in the Savannah groups from lower to upper; the number of children in these families ranged from one to five. More parents in the Tallahassee than in the Savannah groups were highly educated.

The experimenter led three series of group counseling meetings (initiated with the Tallahassee group and repeated with two Savannah groups) in which the participants developed their own agenda of concerns. Programs developed around the behavior of the preschool child, the programs

of the preschools as they related to the parental concerns, principles of child guidance, and family relations.

The significance of the difference for paired observations in which each subject served as his own control was calculated for each group using initial and final scores of participants. Both initial and final scores of the Tallahassee group were more favorable than those of the two Savannah groups. Even though the final total and subscale scores of the Tallahassee group changed in the direction of less favorable attitudes, the trends were in the direction of more favorable attitudes for the two Savannah groups, participants attending more meetings showing greater gains. Gains for participants attending four to eight meetings in Savannah Group II approached significance for the subscale, Hostility, and reached the .05 level of significance for Verbal Behavior.

Although the gains of participants attending four to eight meetings were greater than gains made by parents attending fewer meetings, no significant differences were observed when the differences of these two groups were analyzed by the median test.

Initial scores of participants were found by analysis to be independent of the sex of the parent. Significant relationships were found between social class and the total scale at the .05 level and between social class and the subscale, Toilet Training, at the .001 level, the upper and upper-middle classes having more favorable attitudes than the lower-middle and upper-lower classes. A relationship significant at .05 was found between the subscale, Boy-Girl Differences, and the number of children in the family, parents of large families having more favorable attitudes than parents of small families on this subscale.

Microfilm \$2.50; Xerox \$3.60. 61 pages.

SOME INTELLECTUAL ATTRIBUTES AND EDUCATIONAL INTERESTS OF UNIVERSITY WOMEN IN VARIOUS MAJORS

(L. C. Card No. Mic 60-740)

Louise Gentry, Ph.D. The Ohio State University, 1959

This study of some intellectual attributes and educational interests of university women was designed primarily to determine the extent and significance of differences between women majoring in various subjects. Another concern was with the differences between women currently enrolled and alumnae who were students during recent years.

The sample consisted of two groups of Ohio State University women: (1) alumnae who graduated in June, 1954, and who had initially enrolled Autumn Quarter, 1950, and (2) seniors who expected to graduate in June, 1959, and who had entered the university Autumn Quarter, 1955. The original sample of 219 alumnae and 289 seniors included all the women whose entrance and graduation dates coincided with the above stipulations and who were enrolled in those areas of study commonly pursued by women. For analysis purposes the women were classified in major groups as follows: (1) business; (2) elementary education; (3) fine arts and music; (4) home economics; (5) humanities, science, and social science; and (6) other majors.

The intellectual attributes examined were limited to academic ability, as indicated by scores on the Ohio State Psychological Examination and the Ohio State English Placement Test, and to academic achievement as indicated by rank in high school class and college cumulative pointhour ratio. These data were available in college records. The educational interests considered were identified by the use of a questionnaire, "Educational Interests of Women Seniors and Alumnae at The Ohio State University." Many of the responses were categorized as reflecting either broadening-cultural-intellectual or personal-practicalprofessional concerns. There were 159 alumnae and 238 seniors who responded to the questionnaire -- 78 per cent of the original sample. Since there was no significant difference in the intellectual attributes of the women who answered the questionnaire and those who did not, it was assumed that the women who responded were representative of their classes. The statistical procedures used in summarizing and analyzing the data were the computation of percentages, analyses of variance, and Chi squares.

The women in the original sample majoring in the various fields demonstrated a significant difference in academic ability and also in academic achievement as indicated by college cumulative point-hour ratio and, in the case of the seniors, rank in high school graduating class.

There was no significant difference however, between the alumnae and the seniors in intellectual attributes; therefore, it can be assumed that variations in educational interests of the graduates and seniors were due to other influences.

In most instances the educational interests of the Alumnae and seniors were more alike than different. There was a significant difference, however, in the ways in which the two groups valued their total college program. The fact that the alumnae tended to emphasize personal-practical-professional interests may be a reflection of the

graduates' current involvement in homemaking and vocational responsibilities.

As far as major groups were concerned, there was a significant difference in the kind and breadth of basic educational interests as indicated by reasons for being satisfied or dissatisfied with choice of major, ways of valuing college education through work in major field, choice of elective courses, selection of courses valued highly, and reasons for esteeming particular courses. There were no significant differences, however among the various major groups in reaction to final choice of major, ways of valuing college education through the total college program and through extracurricular experiences, and extent of and reaction to extracurricular activities. Despite these similarities, the data substantiated the conclusion that women majoring in various subjects differ significantly not only in intellectual attributes but also, in essence, in kind and breadth of basic educational interests.

Microfilm \$4.20; Xerox \$14.65. 325 pages.

RELATIONSHIP OF STUDENTS' ESTIMATES OF TEACHER CONCERN TO TEACHING EFFECTIVENESS

(L. C. Card No. Mic 60-616)

Elizabeth Madeline Ray, Ph.D. Cornell University, 1959

This study was undertaken to investigate the potential of student ratings of teachers for determining the effectiveness of teaching. Specifically, it was directed to a questionnaire called the Student's Estimate of Teacher Concern or SETC developed by Nygren and said to comprise important factors for quality interaction between teachers and pupils. The purposes were threefold: (1) to revise and improve the SETC; (2) to establish if the SETC is a valid index of quality in teacher-pupil interaction; and (3) to establish if the SETC is related to other criteria of teaching effectiveness.

Nygren outlined a concept of interaction called "teacher concern for individual students." Teacher concern was defined as "a condition in which a teacher has communicated to a student regard for his well-being." Concern is said to lead to increased insight on the part of the teacher. The frame work of the concept of concern contains four dimensions:

- (1) recognition identification of an individual as a particular person different from others.
- (2) understanding . . knowledge of the causal factors related to the behavior of the individual.
- (3) help I communication of a desire to help the individual.
- (4) help II advice and/or some kind of action which will help the individual.

The study was conducted in nine central schools of New York State and included 468 junior high school girls who were taking homemaking from teachers who were recent Cornell graduates. The mean SETC score for the population was 271.31. Individual questionnaires yielded scores ranging from 77 to 366 with a standard deviation of 60.86; the standard error of measurement was 13.39. An F-value significant at the one percent level supported by a series of t-tests indicated that the mean SETC scores discriminated to some degree among the nine teachers, with scores of teachers ranking first, second and third significantly different from all teachers except those assigned adjacent ranks.

The odd-even reliability coefficient for the total SETC was .95; those for the four dimensions were in the eighties. Intercorrelations of the dimensions revealed significantly high r's (70-81) to necessitate the rejection of the hy-

pothesis predicting separate measures.

The students' ratings of the teachers' relative interest, understanding and help, which were intended to validate the SETC scores, proved to be unusually effective with r's in the 90's resulting from correlation of mean scores with mean SETC scores. An additional measure of validity, the teachers' estimates of relative concern for individual students, also produced positive relationships. Although the mean estimates of awareness correlated only .55 (significant at ten percent level) with mean SETC scores, the estimates of understanding, desire to help and help given, with r's in the 70's were correlated at the one percent level of significance.

Combined ratings of effectiveness by three professional associates of the teachers were correlated with mean SETC scores producing an r of .60 which is significant at the ten percent level. An r of -.01 between mean SETC scores and scores on the Minnesota Teacher Attitude Inventory

did not corroborate these findings.

Data on four indices in addition to the SETC were complete for eight teachers, and were sufficiently alike to yield a significant concordance coefficient. Therefore it was possible to combine the four ranks and assign a ranking which was highly consistent with ranks derived from SETC scores. If the composite ranks are used as the criteria of effectiveness only one teacher was misplaced by the SETC.

These findings gave substantial support to the SETC as a measure of quality interaction between teachers and pupils. Microfilm \$2.50; Xerox \$6.40. 134 pages.

FURNITURE AND HOUSEHOLD TEXTILES OF RESIDENTS OF MIDDLE FLORIDA, 1820-1865.

(L. C. Card No. Mic 60-1417)

Jane Kelly Shearer, Ph.D. The Florida State University, 1960

The first settlers who came to Territorial Middle Florida to make their homes came to an undeveloped area from which a way of living was destined to be shaped by their own efforts. Families often accompanied these pioneers to the land where they hoped to establish a culture such as that found in other southern states. Others brought their families when they could provide a place to live. Marriage records indicate that those who arrived single or widowed did not let frontier conditions interfere with the establishment of homes. Some of the very early houses were built of logs, but as times became settled these were generally replaced by large and somewhat elegant houses.

Inventories made by executors of estates disclose that early Florida settlers possessed a quantity of household items. The items of furniture and the two textiles presented in this study can, however, represent only a small portion of the total which was in use. A majority of the items still extant and documented in this investigation once belonged to settlers who were outstanding in the community.

If the assumption is made that the furnishings herein presented are representative of what was found in the antebellum homes of those who prospered in the community, the following conclusions may be drawn:

- (1) Families migrating to Middle Florida brought with them little furniture. The near-absence of eighteenth century pieces would support the belief that only infrequently did treasured family heirlooms accompany the family. In style, the majority of the items found may be dated after 1800 with a large percentage of these having style characteristics of 1830 and after.
- (2) Generally, the furniture appears to have been American-made since standard texts on American, more often than texts on foreign furniture, yield illustrations which more nearly duplicate the items recorded. References on English furniture afford no examples which replicate any of the Florida pieces, nor is there sufficient similarity to designate, with certainty, that any of the items were made in England. Those few items which seem to be French are probably examples of the revival, under Louis Phillipe, of Louis XV styles.

(3) The settlers of Territorial Middle Florida bought some furniture both from foreign and from the larger American markets; they did not depend entirely upon local

sources

- (4) With the exception of a seeming preference for highpost beds, current styles in furniture seem to have been preferred by the settlers. The increasing number of extant pieces which seem to date as mid-century or beyond in any given style could, of course, be due, in part, to less frequent loss and less deterioration of the later items.
- (5) If the quality of the window hangings can be judged by the elegant window cornices which topped them, and if upholstery fabrics may be assumed to be of a quality commensurate with that of the seating pieces upon which they would have been used, it is reasonably certain that the early residents of Florida used such textiles as might be found in comparable homes in other areas of the country. The two extant textile items documented imply that bed coverings were important adjuncts to the design of bedroom interiors. Microfilm \$2.90; Xerox \$10.15. 221 pages.

JOURNALISM

EVALUATION FOR CONGRUENCE AS A FACTOR IN ACCELERATED ADOPTION OF AN AGRICULTURAL INNOVATION

(L. C. Card No. Mic 60-1485)

Edward Lowell Brandner, Ph.D. The University of Wisconsin, 1960

Supervisor: Bryant Kearl

This research explores the hypothesis that an individual will accept an innovation more rapidly when he sees it as congruous or consonant with previous favorably evaluated practices than when he fails to see it as congruent with a previously evaluated practice.

Two cluster samples of Kansas farmers were interviewed. Half of each cluster consisted of all farmers who had tried hybrid sorghums the first year they were generally available. The other half was obtained by locating for each farmer who had tried hybrid sorghums the nearest neighbor who had not tried hybrid sorghums that year.

Both samples were in areas where farmers had had experience with standard varieties of grain sorghums. One sample was in the hybrid corn region of Kansas; the other was in a section of the state where corn has not been grown commercially. Thus the responses of farmers in position to use a previous, favorably evaluated congruent practice (hybrid corn) could be compared with those of respondents in the section where corn was not produced. Within each cluster responses of those who had tried sorghums were compared with responses of nearest neighbors who had not tried them. Between clusters, responses of both adopters and nonadopters in the corn area and of adopters and nonadopters in the noncorn area were compared.

Responses from all respondents also were recorded on farm practices, socio-economic factors, age, education,

and other factors reported in the literature to be associated with slow or rapid adoption of innovations.

The percentage of farmers who had tried hybrid sorghums the first year they were generally available was nearly four times greater in the hybrid corn area than in the noncorn area of the state.

Farmers in the <u>corn</u> area were significantly more likely (.001 level) to evaluate hybrid corn as better than open-pollinated corn and see similarity in principle between hybrid sorghums and hybrid corn.

Farmers in the noncorn section of the state evaluated significantly higher (at levels from .001 to .05) the economic importance of grain sorghums, importance of salesmen and dealers as a source of information, and experimental fields. The noncorn farmers who tried hybrid sorghums were significantly more likely than corn area adopters to ask for a specific hybrid by number and to know the number of the sorghum they planted. Other indications that noncorn farmers would adopt hybrid sorghums more rapidly than corn area farmers (opposite from what happened) were that the noncorn farmers had owned combines significantly longer, had sprayed against weeds significantly earlier; ranked grain sorghums as their most important crop economically, and were in the grain sorghum producing section of the state.

Despite the many factors (and others at nonsignificant levels) that data in the literature have related to rapid adoption of innovations favoring the noncorn farmers, they tried hybrid sorghums only about one fourth so fast as did the corn area farmers.

It was concluded that the hypotheses could not be rejected. The research strongly suggests that individuals in position to use previously adopted practices to evaluate subsequent innovations will adopt the subsequent innovations much more rapidly than individuals who use other evaluative processes. Microfilm \$2.55; Xerox \$8.80. 195 pages.

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

AN EDITION OF WILLIAM DEAN HOWELLS'
LITERARY FRIENDS AND ACQUAINTANCE,
WITH AN INTRODUCTION TREATING LITERARY
REMINISCENCE AS A GENRE.

(L. C. Card No. Mic 60-1259)

David Franklin Hiatt, Ph.D. The University of New Mexico, 1960

Literary Friends and Acquaintance was first published in Harper's Monthly (1894, 1895, 1900), with one section,

"Studies of Lowell," in Scribner's (1900). It was published in book form in December, 1900, and reprinted in a library edition in 1911. Howells revised considerably between the magazine and the first book printing; consequently, the first step in editing was collating the book with the magazine articles. There was no further revision for the 1911 edition, save the correcting of a few obvious printers' errors.

The goal in editing <u>Literary Friends</u> has been to annotate events, ideas, and people thoroughly as they have been presented by Howells. The approach attempts to expand, as well as identify, that which has been obscured by time. The informed reader of 1895 to 1900 probably had a certain

familiarity with the material in the book that we no longer have. Also, writing after a lapse of thirty years about his first trip to New England, Howells occasionally does not recall accurately or does not fully present important events, then or later; an attempt has been made, through the use of Howells' works and letters and through the works of contemporaries and literary histories, to clarify these. As an instance, he presents his case against transcendentalism, but leaves much to be said; again, an attempt has been made to inquire into Howells' treatment. His relationships with certain other writers are sometimes hazy, and both in the notes and in Appendices A and B these are examined.

Howells' literary output was prodigious, and his non-fiction, his novels, and his reviews and essays in Atlantic and Harper's have yielded valuable information that elucidates Literary Friends. Further, he was a prolific letter-writer, and the letters contain highly relevant and orderly information concerning Howells' literary and personal life. Of course Howells himself used his own correspondence files extensively in verifying certain facts for the book.

Appendices A and B explore Howells' literary relationships with various writers of his time. Howells made few friends and some enemies in his crusade for realism; and saw some of his friendships become less clear. Appendix A treats Howells' association with John W. De Forest, Hjalmar Hjorth Boyesen, two close and helpful friends, and J. J. Piatt, a problematic one. Appendix B deals with four friends--Taylor, T. B. Aldrich, E. C. Stedman, and R. H. Stoddard--who disagreed entirely with Howells' theory of realism, but who remained on good terms largely through Howells' tact.

Appendix C is a consideration of the surviving manuscript fragments of Literary Friends, and Appendices D and E show differences between the magazine and the book printings that were too extensive to be handled in the notes. From these changes, Howells' care in correcting and rewriting can be seen.

The introduction treats literary reminiscence as a genre, showing how it differs from autobiography in its focus on the writer's development, his literary associations, and his concern with his work. The critical approach used here does not depend so much on veracity and candor, as do most approaches to autobiography and reminiscences; but rather on the author's "level of reality" -- what things and concepts are important for him and how they are presented. Several reminiscences are explored in the light of this approach and some, such as Goethe's, found to be outstanding; while others, such as H. Rider Haggard's, seem contrived.

Finally, the introduction deals with nineteenth century American literary reminiscences and particularly with Literary Friends. Certain things that Howells considers important are traced through for their meaning, as are certain ideas. Howells' methods, objectives, and presentation are explored as they serve to mold his work into a well structured and effective reminiscence.

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Microfilm \$7.05; Xerox \$25.00. 555 pages.

THE RELIGIOUS IDEAS OF SOME MAJOR EARLY WRITERS OF AMERICA

(L. C. Card No. Mic 60-383)

Robert Walter Root, Ph.D. Syracuse University, 1959

Please see abstract on page 4378. Microfilm \$12.65; Xerox \$45.05. 1001 pages.

THE SEARCH FOR FELICITY: A STUDY OF THE RELIGIOUS THOUGHT OF JAMES BOSWELL IN THE LIGHT OF THE RELIGIOUS DEVELOPMENTS OF EIGHTEENTH CENTURY ENGLAND AND SCOTLAND.

(L. C. Card No. Mic 60-841)

Mary Margaret Stewart, Ph.D. Indiana University, 1959

"Those who remark their religious experiences," wrote James Boswell, "are generally looked on with Ridicule; but very unreasonably, for they are experimental philosophers upon the most important subject." Drilled in doctrines of Calvinistic theology as a child by his mother and tutors, Boswell rebelled against this indoctrination and the terror it had instilled by joining with Methodists and then by escaping to London in March 1760 to embrace the Roman Catholic faith. In London under the influence of Lord Eglinton he renounced Catholicism and became instead a deist. Upon his return to Scotland he began reconstructing his faith -- a process which continued throughout the years of his Grand Tour. This study examines Boswell's religious experiences. It first traces his religious training and development, noting in particular the influence of his pious mother, of his stern father, of his tutors and friends, especially Doctor Johnson. It examines his struggles to accept the Christian revelation, to banish doubts and religious gloom, to formulate a new concept of God. It studies his continued efforts to be a rational Christian, his concern over his children's religious training, his stand against infidels despite his own recurring doubts. Lastly, it reveals his doubts, problems and hopes -- his desire to believe man free, his inability to accept Calvinistic doctrines of the Scottish Church, his hope for eternal life, a hope severely shaken by his last interview with David Hume.

Part One of this study is a survey of significant religious thought and developments in eighteenth century England and Scotland. The first chapter defines rational Christianity and indicates problems which arose when seventeenth and early eighteenth century divines, assured there was no conflict between reason and Christianity, invited men to test the reasonableness of the Christian revelation and dogmas. The controversy over the Trinity is reviewed with the positions of orthodox Christians, Arians and Socinians compared. Deism, its concepts of God and Creation, its attacks on the Christian Church, its deterioration into sceptical deism, is studied. Finally, Calvinism and Arminianism are compared in an endeavor to explain why Calvinism with its annihilation of natural man was so unexceptable to optimistic rationalists. The second chapter is a brief examination of three movements which disturbed

orthodox Christianity within this century -- scepticism as exemplified through the philosophical works of David Hume, infidelism as illustrated in Edward Gibbon's work The History of the Decline and Fall of the Roman Empire, and Unitarianism as preached by Joseph Priestley. The final chapter is a historical sketch of the National Church of Scotland. Problems which arose because of church patronage and heresy within the church are revealed; the development of two church parties, Moderate and Evangelical, and events which lead to schism in the church are traced.

The material in Part One, then, is presented not only to give background to the study of Boswell but also to illustrate how closely Boswell was connected with the movements of his day and how his doubts reflected the questions of his age.

Microfilm \$3.70; Xerox \$13.05. 287 pages.

EDMUND SPENSER'S THEOLOGY

(L. C. Card No. Mic 60-1394)

Daniel Douglas Waters, Jr., Ph.D. Vanderbilt University, 1960

Supervisor: Professor Claude Lee Finney

The purpose of this dissertation is to show that Spenser's theology is Anglican and that it has its basis in the Protestant scholasticism of the humanistic wing of the Huguenot movement in sixteenth century France. Some, however, have tried to prove that his theology is either Catholic or Calvinistic.

The method employed here is a consideration of Spenser's theological ideas chronologically in his poems in the

light of Huguenot humanism.

Chapter I gives a survey of the development of the Neo-Platonic Christian tradition in the earlier Christian theologians, especially St. Augustine and St. Bernard of Clair-vou, in the revival of this theology in Ficino and Pico della Mirandola, and in the humanistic Huguenot contributions, particularly Du Mornay's works.

Chapter II demonstrates that Spenser in his early poems, especially The Shepheardes Calender, is Anglican and not Puritan in his acceptance of vestiments and episcopacy and in his condemnation only of moral and religious

abuses within the Anglican Church.

Chapters III and IV comprise the very heart of this whole dissertation. They deal in a systematic way with Spenser's theological principles in his entire works, comparing them in detail with Du Mornay's Trewnesse of the Christian Religion. Spenser's doctrine of Eternal Providence, Destiny, and Fortune is like the beliefs of Du Mornay and Boethius. Spenser accepts the traditional concept of God, including the Trinity; he believes with Du Mornay in man's free will and rejects Calvin's concept of particular predestination or election. Only those people go to the House of Pride or to the House of Holiness who freely choose to go. Spenser, like Ficino and others, believes that virtue is inherent in man's soul, although some of it was lost at the fall. Both before and after the fall man had two lights - a divine inner light and a natural light. But at the fall the inner light was dimmed - the soul lost part of its magnanimity or greatness of soul. Hence because of original sin man's soul suffers a deterioration in its higher faculties - understanding and will. The grace of God restores magnanimity to man's soul and makes possible its growth into spiritual insight and mystical union with God. Prince Arthur, who is brought to the rescue of Red Crosse by the grace of God, stands for magnanimity, not for grace itself. He is an agent of grace. Spenser's stress upon the importance of good works is un-Calvinistic and Anglican as well as Catholic.

Chapter V analyzes Spenser's Anglican employment of the following traditional religious symbols: altars, crosses, patron saints, hermits, vestments, and the garments of

Fidelia, Speranza, and Charissa.

Chapter VI analyzes Spenser's use of traditional Mediaeval religious mysticism, especially that of St. Bernard of Clairvou, in "An Hymne in Honour of Heavenly Love," in "An Hymne in Honour of Heavenly Beautie," and in the tenth canto of Book I of The Faerie Queene.

Chapter VII analyzes the growth of the character of the Red Crosse Knight from an immature Christian to a Mature

saint.

And Chapter VIII analyzes the allegory of love in the Legend of Holinesse in which the love of Red Crosse for Una becomes a symbol of divine love - love of man for God.

My conclusion is that Spenser's theology is neither Catholic nor Calvinistic but Anglican with its basis in the Neo-Platonic Protestant scholasticism developed by the humanistic wing of the Huguenot movement in sixteenth century France. His entire emphasis is exactly like that of Du Mornay and other Huguenot humanists.

Microfilm \$4.75. Xerox \$16.65. 369 pages.

RAWDAT AL-MURĪDĪN [of] SHAYKH ABU JA'FAR IBN-YAZDĀNYĀR.

Edited and Translated by John Alden Williams.

(L. C. Card No. Mic 59-1557)

John Alden Williams, Ph.D. Princeton University, 1958

"A Garden for Seekers" is a critical edition and translation of the Arabic Sufi work, Rawdat al-Muridin, of Shaykh abu-Ja'far Muhammad ibn-al-Husayn ibn-Ahmad ibn-Yazdānyār. The manuscripts of Princeton, Paris, Berlin, and Cairo are the sources of the edition. The author's dates are unknown, there is some confusion as to his name, and the earliest known manuscript is dated 651/1253. On examination of the manuscripts and the internal evidence, it is possible to state confidently that the author's name is as here given, and that the book was written about the first quarter of the fifth Islamic century.

In form, the book stands midway between Sufi treatises and adab literature. It consists of sayings and anecdotes arranged in chapters, illustrating virtues or aspects, of Sufi life. It has been influenced by an earlier work, the Kitāb al-Luma' of abu-Nasr al-Sarrāj, and contains some of the same material, together with other anecdotal material not preserved in the surviving published literature.

The sayings of some one hundred and fifty Sufis are mentioned, together with verses of poetry, quotations from the Koran, traditions of the Prophet and sayings of the Companions and Followers.

The book is addressed to the "seeker," or novice, and was intended originally for the Muslim public, rather than the mystic. Although the note of apologetic for the orthodox wing of Sufism is not absent, the chief aim of the author is to elevate the reader, and to stress the value of mysticism as the perfection of faith.

The names of those quoted, with a few exceptions which need no introduction, are listed in the introduction, with their death dates, a brief evaluation, and references.

Microfilm \$4.60; Xerox \$16.20. 357 pages.

LANGUAGE AND LITERATURE, MODERN

GABRIEL DE ESPINOSA, "EL PASTELERO DE MADRIGAL," IN HISTORY AND LITERATURE.

(L. C. Card No. Mic 60-1258)

Mary Elizabeth Brooks, Ph.D. The University of New Mexico, 1960

On August 4, 1578, King Sebastian of Portugal died on the battle field at Alcazarquivir, and two years later, the throne of Portugal was occupied by his uncle, Philip II of Spain. The loss of political autonomy was a bitter blow to the Portuguese people, but they found cause for hope in the rumors that Sebastian still lived. No one had seen the young king killed, and it was said that he had returned secretly to Portugal with the fleet after the battle. During the next thirty years, four false Sebastians were imprisoned and sentenced by the Spanish authorities: two in Portugal, one in Spain, and one in Italy.

The Spanish impostor, known as the "pastelero de Madrigal," is the only one who moved from history into literature, exciting the imaginations of writers by his grand manners and mysterious airs. Although Gabriel de Espinosa was certainly not Sebastian of Portugal in disguise, he refused, even under torture, to reveal his true identity. According to the documents in the Archivo General at Simancas, Spain, which make up the proceso against Espinosa, he was an unknown adventurer with a flair for the dramatic. Under the tutelage of Fray Miguel dos Santos, former preacher to the royal family of Portugal, Espinosa was accepted as King Sebastian by Doña Ana de Austria, illegitimate daughter of Don Juan de Austria and niece of Philip II. It was Fray Miguel's plan to increase the impostor's prestige by marrying him to Doña Ana and then force Philip II to restore him to the throne of Portugal. All was going smoothly until Expinosa committed the grave error of displaying to disreputable companions the jewels which Doña Ana had given him. He was denounced to the authorities as a thief, and his arrest led to the exposure of the entire conspiracy. Fray Miguel and Espinosa were convicted of treason and hanged in 1595. Doña Ana was punished by a period of strict confinement.

Through out the investigation, Espinosa's insinuations and half-tru hs led many people to believe that he was more than a humble pastry-maker, and it was this aspect of his character which prompted the writing of a small

volume entitled Historia de Gabriel de Espinosa, immediately after his death. The anonymous author was an eyewitness to most of the events and gives a fairly accurate account except for the details concerning Espinosa's mysterious conduct in prison. The Historia enjoyed wide circulation and became the principal historical source for later writers who did not have access to the proceso documents.

An anonymous comedia, attributed both to Jerónimo Cuéllar and to José de Canizares, was published in the mid-eighteenth century under the name El Pastelero de Madrigal. A refundición of this comedia is still unpublished. Espinosa enjoyed his greatest popularity, however, during the Romantic Movement. Earlier authors had presented him as an interesting impostor who deserved death on the gallows, but the romantic writers preferred to identify him as King Sebastian of Portugal who met a martyr's death through the treachery of Philip II. The romantic novels, Ni rey ni roque by Patricio de la Escosura and El Pastelero de Madrigal by Manuel Fernández y González, are mediocre works. The culminating literary interpretation of the pastelero is to be found in José Zorrilla's play, Traidor, inconfeso y mártir, in which the persons of king and pastry-maker are successfully fused into one dramatic character.

This work attempts to study the person of Gabriel de Espinosa as revealed in all available historical documents and to show the mutations of character brought about by its adaptation as a literary theme in various genre of Spanish literature.

Microfilm \$4.85; Xerox \$17.10. 378 pages.

THE NATURE OF MAN'S RELATIONSHIPS AS EXEMPLIFIED IN THE PLAYS OF GABRIEL MARCEL

(L. C. Card No. Mic 60-1356)

Anne Therese Farraher, Ph.D. Stanford University, 1960

The study of man's relationships with himself, with others and with God is an essential part of Gabriel Marcel's philosophy and the basic theme of his plays. Instead of soaring to a realm of abstract truths and scientific methodology, he attempts to restrict his considerations to the predicaments of contemporary man in his everyday relationships.

According to Marcel, man's journey from existence to being is identical with the way from solitude to communion. In this dissertation I have studied Marcel's ideas about communion under three of its aspects and then considered the illustration of these theories in his plays. Marcel's analysis of the individual's relationship with himself is discussed first. In this connection, Marcel is particularly concerned with the difficulty of arriving at self-knowledge and, at the same time, the necessity of continually striving towards a better understanding of ourselves if we are to lead an authentic life. Then his ideas on our relationships with others are analyzed. The other person becomes for me a "being" only inasmuch as I approach him with respect and regard him as a centre of freedom and responsibility; that is, inasmuch as he is a "thou" to me. The authenticity

of my life, according to Marcel, is in proportion to my ability to achieve this union with others. Finally we consider Marcel's theories concerning man's union with God. which is, at the same time, the basis of his union with himself and with others, and also the ultimate goal of his life. Like a motif these three themes run through all of Marcel's plays. In this study references are made to many of his plays, but three particular plays are discussed at some length, because the themes mentioned above are better isolated in them: Un Homme de Dieu, the analysis of a man who finally becomes aware of the self-deception in his life; Les Coeurs avides, the study of a woman who is inspired to enter into closer union with her self-centered husband; and Rome n'est plus dans Rome, the courageous journey of a man from religious unbelief to full acceptance of Christ and His teachings.

Marcel's plays certainly bring the thoughtful reader to a fuller realization of the need for sincerity in all of our relationships if we are to lead an authentic and full life. We have attempted in this study to show not only to what extent Marcel has exemplified in his plays modern man's "estrangement," but also to what degree his plays offer a solution to this problem. Marcel, haunted by the realization of the alienation of man, traces the source of that alienation to man's "having." The individual becomes possessed, as it were, by the objects he possesses - his house, his books, his factory, his ideas, his opinions. This captive soul is cut off from real contact with other persons; man is no longer able to respond to another's "presence." Marcel speaks of this individual's suffering "an ontological deficiency." He is unavailable to himself, to others and to God, and consequently he does not participate in "being." Microfilm \$2.85; Xerox \$9.90. 220 pages.

> GEORGE BARKER: TWENTIETH-CENTURY ROMANTIC.

> > (L. C. Card No. Mic 60-1488)

Martha Haller Wilde Fodaski, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Paul Wiley

Although George Barker (1913-) has long been an established modern poet, he has not been given sufficient or wholly accurate critical attention; reviewers and critics have emphasized his style while often failing to recognize its relationship to subject matter. This thesis, based primarily on his poems, aims to explicate, evaluate, and locate the poetry in its proper historical and literary context. It reveals that in almost every detail Barker's aesthetic, themes, style, and growth typify romanticism as it manifests itself in the twentieth century, particularly since the 1930's. Chronological organization and stress on illustrative poems help to emphasize Barker's development and the organic relationship between changing form and content.

Barker began with no systematic knowledge of literature. He became, however, thoroughly involved in the contemporary scene and acquainted himself with literature and thought of a past which he himself chose, one which seems dominated by the nineteenth century. He learned

from his contemporaries, particularly Joyce, Eliot, Yeats, Thomas, and Auden, as well as from Hopkins and Owen. His imagery and themes are often influenced by modern psychology and philosophy. Typically he mixes mythological with Biblical or Freudian with Christian symbols.

In the thirties Barker considered himself a voyant; his long poem Calamiterror (1937) depicts the change from poet-mystic to poet-engage. The forties poems concern his involvement in mankind and his tragic response to social, political, and personal crises. Since 1950 he has dealt with the rebel who learns that, although he cannot wholeheartedly affirm God, he can affirm life; although sometimes the skeptic, sometimes the repentant sinner, he finally equates himself with the Dionysian artist, a yea-sayer despite the negations of life. He has persistently displayed romantic faith in the individual, although in accepting scientific determinism and transcendental vision, he has inevitably created poetry of conflict. Romantic religious feeling struggles against the pull of natural, instinctive life. Out of the clash of opposites Barker makes poems.

Stylistically his task has been to create a genuine unity of form and content. The voyant uses words primarily for their sound and evocative power; the prophet uses them expansively as counters for ideas and for things and events which become a symbolic or metaphoric comment on contemporary life; the Dionysian uses a compressed and consistent symbology. The early poems resemble Symbolism and Surrealism; the middle work reminds us of the New Romantics' eschatological world view and emphasizes the real world where knowledge and experience provide poetic insight; the recently chastened style, reflecting tension between spiritual aspiration and the sense of moral turpitude, reminds us of late nine-teenth-century Romanticism.

At his best Barker is able to reconcile the opposites which constitute his imagery and subject matter; he creates an organic form, a poem which makes its own rules, through using a consistent symbology or pattern of associations. Because his errors are egregious, critics have too often thrown away the wheat with the chaff; they have not accepted the poems on their own terms, as works which stand up under analysis if the critic does not approach them with a preconceived idea of what a poem should beside he grants Barker his intuition. His artistic vision is not at present wholly fashionable because of its stress on emotional intensity, conflict, and the energetic quest for individual discovery. Barker's poetry exemplifies twentieth-century romanticism, sometimes at its worst, but more often at its best.

Microfilm \$6.10; Xerox \$21.60. 479 pages.

THE RELATIONSHIP BETWEEN ART AND DISEASE IN THE WORKS OF THOMAS MANN

(L. C. Card No. Mic 60-857)

William Valentine Glebe, Ph.D. University of Washington, 1959

Chairman: William H. Rey

The artist's "disease" I found to be a central Leitmotiv in Thomas Mann's work. My thesis analyses the development

of this theme from the early stories up to the late novel Doktor Faustus. In the introduction, emphasis is placed upon the fact that Thomas Mann's concept of disease is influenced by the Romantic tradition of German literature and, therefore, has broader implications than the usual medical term. Disease in this respect is whatever distinguished the Künstler from the unproblematical, healthy naivety of the average Bürger. Disease, then, accounts for the hyper-refinement of the artist's esthetic sense and for the acuity of his critical intellect, but also for his lack of vitality. In the conflict between art and life, which is the main subject of Thomas Mann's early tales, the artist has hardly a chance of survival. I point out in my work, however, that in the course of Thomas Mann's development, the artist's disease loses its destructive character. Tonio Kröger rejects the lure of death in favor of a positive assertion of life, which anticipates Thomas Mann's turning away from the Romantic heritage towards the Classical tradition as represented by Goethe. In spite of certain relapses, as for instance in Tod in Venedig, the mature works of Mann, beginning with Der Zauberberg, reflect his search for a reconciliation of disease and health, art and life, the outcast-artist and human community. The climax of this development I find in Thomas Mann's Goethenovel, Lotte in Weimar. The genius of Goethe achieved the great synthesis by transforming the artist's disease into a creative power which is completely integrated in the ironic polarity of his personality. This superior state of health is denied Adrian Leverkühn, the protagonist of Doktor Faustus. Thomas Mann's late novel is characterized by a renewed emphasis upon the destructive power of disease which now appears as a diabolic agent and leads to the downfall of the artist. My view, however, is that Doktor Faustus cannot be considered as a mere relapse into the pessimism of Mann's early works. In the last analysis, the disaster of the artist reveals itself as an act of utter self-sacrifice for the future benefit of art and humanity. In contrast to the conventional interpretations, it is my view that even in Doktor Faustus disease fulfils a positive function in the evolution toward cultural regen-Microfilm \$3.50; Xerox \$12.40. 271 pages.

FIVE DRAMAS OF LUDWIG TIECK HITHERTO UNPUBLISHED. A CRITICAL EDITION. (PARTS ONE AND TWO).

(L. C. Card No. Mic 59-3420)

Albert Browning Halley, Ph.D. University of Cincinnati, 1959

This dissertation has two main purposes: to make five of Ludwig Tieck's early unpublished dramas, written probably in 1789 and 1790, available to further criticism in a text which faithfully retains the peculiarities of the manuscripts; and to provide a critical study of these dramas, paying particular attention to the discovery and analysis of Tieck's literary sources, as an understanding of them is a key factor in determining the nature of Tieck's artistic impulses in this early period of his life, which is found to be pre-romantic. The five dramas chosen for discussion are Medea, Meiners, Gotthold, Siward, and Braddeck.

Since the five dramas are tragedies, they are more re-

vealing of the thought of the young author and are the most significant of the hitherto unpublished works.

The first part of the dissertation (263 pp.) comprises a detailed discussion of the plays, five chapters being devoted to a study of Medea, which is characterized as a melodrama in the literary and musical tradition established by Rousseau's Pygmalion, Johann Christian Brandes's Ariadne auf Naxos, Gotter's Medea, and the music of Georg Benda. The history of this form to 1789 is discussed, and its relationship to the Gesamtkunstwerk or music-drama is envisaged. The Medea of Gotter, not that of Klinger, is found to be Tieck's principal source Other sources are adduced: Glover, Shakespeare, Ossian, the Bible. Other works of Tieck which partake of the melodrama: Sommernacht, Kater, Verkehrte Welt, and Genoveva, are considered. Tieck's Medea anticipates his application of musical and operatic principles in the composition of his later works. From the melodrama come, in the main, his use of tone painting, leitmotif, and other important principles of the Gesamtkunstwerk. This section closes with a discussion of Tieck's theories of the Gesamtkunstwerk in general. These theories are not only implied by Tieck's works but are outlined by him at length. They were not derived from Wackenroder, as has been claimed, but were developed independently. Tieck's original theories of music are basically different from those of Wackenroder. Tieck's thought is more original than has been supposed.

To each of the other four dramas one chapter is devoted. Meiners is studied in its relationship to the middle-class drama but is found to represent a pre-romantic attitude. There are many striking similarities to Medea.

In Gottheld considerable influence of Shakespeare's Romeo and Juliet, Hamlet, Macbeth, As You Like It, King Lear, and Cymbeline is discovered. Differences between it and the traditional drama of knighthood are noted. The action takes place at the court of the legendary King Arthur. The conclusion of this fragmentary drama adduced by Regener is not supported by internal evidence.

Siward is studied in the light of Shakespeare's Macbeth and Hamlet and the influence of the Storm and Stress. Like the other plays, it is found to be pre-romantic (absence of didacticism, interest in the subject-matter for its own sake, mediaeval setting, use of Shakespeare's principles of composition).

Braddeck is one of the most interesting and significant of the five dramas because of the fairy-tale elements which pervade it. The influence of Shakespeare is much more clearly traceable than Hemmer believes. Shakespeare's As You Like It is the main source. Nearly the entire conclusion is from Macbeth. Other influences are Shakespeare's Cymbeline and The Merchant of Venice, Ovid, Lohenstein, and Voltaire as well as Gozzi. The sources are more diverse than previously thought.

The second half of the dissertation (168 pp.) presents a diplomatic text of the five plays, based upon photostats of the manuscripts. This is the first time the texts have been transcribed.

Microfilm \$5.55; Xerox \$19.80. 436 pages.

FRANK NORRIS'S HEROINES

(L. C. Card No. Mic 60-1489)

John Stanley Hill, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Harry Hayden Clark

This dissertation is a study of the three principal ways in which Frank Norris uses the role of the heroine in his novels: one, the heroine as a naturalistic character who demonstrates the decline of a person because of the effects of heredity and environment; two, the heroine as an example of what Norris thought woman should be; three, the heroine as the embodiment of all of the virtues granted to woman by nature and fertility myths.

As for the first use, the character of Trina Sieppe, in McTeague, is used to show that the decline of an individual is the result of the effects of heredity and environment. Also, Trina's decline is shown to be responsible, in large part, for the decline of McTeague, for he, too, suffers from the result of her hereditary instincts.

The second use of the heroine, the illustration of Norris's views on the role of woman, begins with the character of Moran Sternersen, in Moran of the Lady Letty, is given refinement in the role of Travis Bessemer, in Blix, is further developed in the person of Lloyd Searight, the heroine of A Man's Woman, and is shown in its culmination in the role of Hilma Tree, in The Octopus. Norris's presentation of this type of woman also includes a character whose role is to show what woman must not be. This adverse side is illustrated by the role of Laura Dearborn, in The Pit, and, to a far smaller degree, by Annie Derrick, in The Octopus.

The third use of the heroine, that of woman eternal, is shown in the portrayal of the character of Hilma Tree, in The Octopus. In creating Hilma, who is his finest woman character, Norris bestows upon her many of the virtues which nature and fertility myths grant to woman. Hilma represents goodness, feminity, and fertility; she represents woman as the source of all life, of all inspiration, and of all true achievement. She also reveals what is the culmination of Norris's thoughts about the role of woman.

This role is first dealt with in Moran of the Lady Letty, wherein the heroine, Moran Sternersen, represents woman in the primitive state. Next, in Blix, Norris shows woman as also possessing refinement. But Travis Bessemer, in Blix, does not use her powers as a woman to exert any great influence upon a man; this is performed by Lloyd Searight, in A Man's Woman, who helps give direction to her husband's life. With the character of Hilma Tree, however, Norris shows what he thinks woman should be: she is independent where she alone is concerned; she possesses sufficient decorum without being prudish; she urges her husband to better himself and his estate, not by demanding such but by exerting a silent influence that makes the man wish to so advance; and she furnishes her man with a goal in life, which is to achieve a high position in the eyes of the woman he loves. Norris achieves this by showing that Hilma Tree, although relatively uncultured, possesses these virtues and, furthermore, by showing that Hilma Tree parallels the concept of the Earth-Mother, Norris comes to represent her not as the actual but as the ideal. In so doing, Norris broadens the potentialities of

the role of woman in fiction and shows how such potentialities may, in part, be treated.

Microfilm \$4.05; Xerox \$14.40. 316 pages.

THE POETRY OF WORLD WAR I: A STUDY IN THE EVOLUTION OF LYRIC AND NARRATIVE FORM.

(L. C. Card No. Mic 60-1491)

John Hubert Johnston, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor Paul L. Wiley

The contrast between Rupert Brooke's brief sonnet sequence, 1914, and David Jones's modified heroic poem, In Parenthesis (1937), summarizes a significant evolution in form, attitude, and technique. It is proposed, therefore, that an analysis of the work of ten representative World War I poets will reveal the main tendencies of that evolution and suggest an interpretation of modern war poetry in terms of a tradition with which it is remotely but generically allied: that of heroic literature. Although it may seem somewhat arbitrary to invoke this tradition with respect to World War I verse, most of the poets who wrote between 1914-18 came to recognize the fact that their work lacked certain important qualities -- objectivity, comprehensiveness, clarity, proportion, and control--that are commonly associated with the attitudes and techniques of the heroic poem. These poets were confronted by a species of warfare that seemed to reverse almost every ideal of heroic action; moreover, they inherited a conventionalized tradition of personal lyric expression which quickly proved inadequate to the themes and materials of the conflict. The present study is concerned with the intensification and enlargement of that lyric response and its evolution toward a broader and more comprehensive poetic statement.

After a preliminary summary of the qualities of heroic literature and the contrasting characteristics of modern war literature, Chapter II deals with the early poets-Rupert Brooke, Julian Grenfell, Robert Nichols--who used the brief personal lyric to dramatize the subjective aspects of a fervent moral and patriotic idealism. Charles Sorley was the first to criticize this rather limited response, which encouraged emotionalized reactions and a tendency to ignore the deeper issues of the conflict; his last sonnets (ironic commentaries on Brooke's 1914) anticipate the later attitudes of Owen and Rosenberg. Chapter III is devoted to Siegfried Sassoon, whose realistic techniques intensified the lyric response without effecting any fundamental enlargement of vision. The next three chapters deal with Edmund Blunden, Wilfred Owen, and Isaac Rosenberg, each of whom stressed perceptions which reflect a broadening sense of tragic involvement. However, these perceptions tended to isolate and magnify the details of personal experience; only toward the end of the war, in the hands of Owen and Rowenberg, did the theme of pity seem about to evoke a more comprehensive statement than the lyric had previously afforded. Although most of the later poets attempted to enlarge and objectify their responses

through the narrative mode, they could not abandon the techniques of lyric visualization; almost all war-time narratives revert to a sequence of disorganized lyric impressions. Two post-war poets, Herbert Read and David Jones, are treated in Chapters VII and VIII. In The End of a War Read sought to go beyond the bounds of lyric statement by eliminating action from his story and concentrating on the "higher reality" of motive and belief; in so doing, however, he excluded the material which had provided the themes and determined the character of World War I verse. Taking advantage of post-war verse innovations (particularly those of T. S. Eliot), Jones originated a complex poetic medium in which the intensities of the personal lyric response were integrated with a narrative framework embodying the spirit and technique of the heroic poem. In Parenthesis, therefore, is a remarkable culmination of the tendencies visible in the poetry directly inspired by World War I.

Apart from their significance with respect to the literature of war, these tendencies afford an interesting parallel to the efforts of post-war poets in general to break out of the Georgian "retrenchment" and establish a more vital and comprehensive contact with the materials of modern life. Microfilm \$6.25; Xerox \$22.30. 492 pages.

JAMES JOYCE AND ASSOCIATED IMAGE MAKERS

(L. C. Card No. Mic 60-1410)

Maria Elizabeth Kronegger, Ph.D. The Florida State University, 1960

This study explores the rich kingdom of Joycean imagery through a revelation of Joyce's kinship in imagery to Edgar Allan Poe and through a comparison of his patterns of imagery with those of representative impressionist, and metaphysical painters.

Poe's imagery and aesthetics came to Joyce in three ways: (1) by direct contact, (2) through the Poe revival in contemporary literature, and (3) through his effect on modern painters.

With the French symbolists (Baudelaire, Rimbaud, Mallarmé), whose indebtedness to Poe is a critical commonplace, Joyce maintained that the artist's concern must be to attain a mystical insight into supraterrestrial reality beyond the world of sensation. For these artists the source of both chaos and spiritual unity is in the mind; therefore, the levels of consciousness are not simply isolated phenomena. They are, rather, symbolic revelations of a transcendental import which take their shape in the mind in terms of complex combinations of experiences in the physical world.

Both Poe and Joyce isolate, fragment, and transpose elements of common experience in strikingly similar patterns of imagery. To dislocate and recombine elements of visual experience is for them an intuitive process whereby the elements of the natural universe may become symbolic revelations of transcendental reality. Fragmentary imagery becomes a means for symbolizing the broken universe of man, time, and space. At the same time, by means of a reassimilation of broken images into ordered geometrical forms, Joyce and Poe attempt to give a spiritual coherence to life and the universe.

The use of circular and cyclic imagery provides a

symbolic synthesis unbounded by the exigencies of time and space. In the works of both authors there appears a steady evolution from the microcosmic circle to ever larger circles that expand in the general universe and relate finally all existence to the cycles of the macrocosmos.

The protagonists of both authors, unable to will order to the external or unconscious experience, are caught in a paralysis which cuts across their physical, intellectual, and spiritual existence. This atrophy of will power is conducive to an urge for wild sensations or acts of perverseness. Both authors recognize in the paralysis of the individual and his consequent frenzy the death of meaning in the world.

Like Poe, Joyce tries to counteract this death of meaning in the world by giving an evocative power to the word. A word engenders a universe. Like a musical note or a pure color, the word takes on power and not only serves as an identifying sign but becomes a dynamic symbol which both participates in and evokes the idea itself. Through the word per se a new and coherent reality arises. By means of the suggestive power of words, Poe and Joyce reveal the essential kinship of all things and souls in an all-pervasive mind, in the profound unity of the world that they perceive.

Poe, Joyce and the impressionist, post-impressionist, and metaphysical painters share in the desire to release the reality which is concealed behind the screen of commonplace. They are the forerunners in this respect of surrealism. With Poe and the surrealists, Joyce tries to get beneath the surface of things, to get the undercurrent of meaning. To go beyond reality and to extend the range of vision is an ideal of modern art. Thus for Poe, Joyce, and these modern painters the complete understanding of the meaning of life consists in being able to perceive the relations between each element of our world and the various aspects of the transcendent entity that lies above and beyond.

Microfilm \$3.75; Xerox \$13.05. 290 pages.

GEORGE TUCKER: MORAL PHILOSOPHER AND MAN OF LETTERS.

(L. C. Card No. Mic 60-1400)

Robert Colin McLean, Ph.D. Washington University, 1960

Chairman: Professor Guy A. Cardwell

The aim of this study of George Tucker (1775-1861), Southern novelist, critic, and philosopher, is to provide an accurate account of Tucker's life, to establish as fully and as correctly as possible the canon of his work, to describe and evaluate his imaginative writings, and to discuss his contributions to America's intellectual history.

Book I, "The Life," based mainly upon Tucker's correspondence and his unpublished autobiography, traces Tucker's careers as lawyer, legislator, man of letters, and Professor of Moral Philosophy at the University of Virginia and discusses Tucker's participation in important nineteenth-century quarrels. Book II, "Tucker as Man of Letters," describes all of Tucker's imaginative writings in the order of their composition; analyzes critically his novels and satires which deal with important social, philosophical, and economic problems; and treats his development as a writer of imaginative literature in the light of

social and economic pressures under which he worked. In Book III, "Tucker as Southern Thinker," a chapter is devoted to each of four subjects which were of paramount interest to Tucker: 1) aesthetics and literary criticism, 2) philosophy, 3) domestic slavery, and 4) the idea of progress and civilization. An attempt has been made to place Tucker's ideas in historical context, to indicate the main sources of his thought, and to illustrate how his opinions developed or changed. Materials for the study of Tucker as writer and thinker are Tucker's published works and such unpublished pieces as his manuscript novel and his notes for lectures on rhetoric and belles lettres. Wherever doubt exists about Tucker's authorship of unsigned or pseudonymous publications, reasons are given for attributing them to him. A check list of Tucker's compositions is included in the bibliography.

The results of this study confirm Tucker's position as a prominent ante-bellum Southern figure, but they indicate that he has been largely misunderstood by biographers and critics. Although Tucker is traditionally interpreted as one of the last of the "Revolutionary liberals," a life-long supporter of Jefferson's political and social doctrines, and a firm opponent of slavery, he was in fact an extremely conservative political and social thinker who defended slavery and who usually opposed Jefferson's policies. As a writer of imaginative literature, Tucker was only moderately successful, but many of his writings are of cultural value for their reflections on nineteenth-century society, for their unusual concern with broad economic and social issues, and, especially, for their interpretation of Southern life and society in terms of Tucker's deeply-rooted belief in human progress.

Investigation into the sources of Tucker's ideas provides important documentation and interpretation of the influence of the Scottish "common sense" philosophy. Although scholars have long believed that the Scottish philosophy flourished in the ante-bellum South, its influence has never been adequately traced through significant Southern figures and institutions. The aesthetic theories of such writers as Dugald Stewart, Archibald Alison, Lord Kames, Hugh Blair, and Adam Smith, which first attracted Tucker to the Scottish philosophy, provided the guiding principles for Tucker's aesthetic and literary criticism and enabled him, for example, to construct upon the doctrines of associational psychology a theory of the nature and function of poetry. Tucker used the philosophical speculations of Stewart, Thomas Reid, and Thomas Brown to attack skepticism and materialism. In the works of Scottish philosophereconomists and historians, among whom were members of the "common sense" school, Tucker found a gospel of social and economic progress which he used to predict and praise the industrialization of American society.

Microfilm \$5.00; Xerox \$17.80. 391 pages.

GUATEMALAN NARRATIVE OF THE NINETEENTH CENTURY

(L. C. Card No. Mic 59-6070)

Michael William Pellino, Ph.D. University of Cincinnati, 1959

The purpose of this study is to analyze and interpret the Guatemalan narrative of the nineteenth century as well as to establish its place in the literatures of other Hispanic American republics and also in relation to general literary developments of that period. In each case, the works of an author are discussed in relation to his life and personality. Therefore, it is sometimes necessary to include mention of works not considered narrative because they assist in describing or characterizing the literary personality of an author. This is sometimes important if works are essays, poems or treatises on international affairs. The study confines itself to Guatemala and the nineteenth century.

Since none of these works are regarded as world classics, summarization of plot and frequent quotations from the works are made to give the reader a better perspective and insight into the works under discussion. It was felt that only in this way would the critical discussion become sufficiently vivid and definite.

The study is divided into two parts: (1) the Introduction summarizes the geographical, historical and cultural developments of Guatemala in order to provide the background for a proper appreciation of the books that are to be discussed in the second part; (2) the seven chapters, which make up the second part, deal with the life and works of the outstanding narrative writers of this period. More space is devoted to José Milla and Máximo Soto-Hall since they are the two most prolific and most widely read writers of the nineteenth century.

We find in our study that regionalism and love of tradition are the most important features in the works of these writers. Although Soto-Hall, who also belongs to the twentieth century writers, wrote on contemporary events, it is his re-creations of the historical past that has made him popular with Guatemalans. José Milla, however, is considered the master of this type of narrative by his countrymen for his reproductions of colonial times and for his portrayals of customs characteristic of the region.

One of the primary concerns of the Guatemalan writers of this period is to preserve the history, culture and tradition of their glorious past. For these men the archives were valuable mines of historical material which they developed in the form of traditions and cuadros.

Data concerning authors and their books was obtained from the critical and biographical works listed in the bibliography which follows this present study. This information was supplemented, in several particulars, through personal interviews, notably with Professor David Vela and other Guatemalans who are relatives of some of the authors discussed in these pages. It is hoped that this bibliography will be of use for those who wish to specialize in Central American literature.

Thus this preoccupation with the past, the struggle for aristocratic privileges, and the strong conservative beliefs on the part of these writers tended to perpetuate an ideological isolationism from the thought and writing of more progressive countries. From this century, however, some outstanding works were produced. Among the longer works, the most successful are biographies and historical novels, such as José Milla's Los Nazarenos, Menco Franco's Don Juan Núñez García, and Máximo Soto-Hall's Don Diego Portales.

Microfilm \$3.05; Xerox \$10.40. 235 pages.

MATHEMATICS

AN ALGORITHM FOR FINDING ALL VERTICES OF CONVEX POLYHEDRAL SETS

(L. C. Card No. Mic 60-1477)

Michel L. Balinski, Ph.D. Princeton University, 1959

An algorithm is described for finding all vertices of a convex polyhedral set defined by a system of linear inequalities. The algorithm is based on a variant of the simplex method of Dantzig and proposed as a computationally feasible procedure, and thus as one with which to find all optimal solutions to a linear programming problem.

Certain graph theoretic properties of convex polyhedral sets are investigated. It is shown that if the vertices of convex polyhedral sets are considered as the points and its edges as the lines of a graph, then the graph so defined is n-tuply connected. Whitney's Theorem of graph theory, which asserts the equivalence of n-tuple connectedness to the existence of n distinct paths between any pair of points, is shown to be derivable from the theory of linear programming.

Microfilm \$2.50; Xerox \$3.00. 43 pages.

ESTIMATION PROBLEMS CONNECTED WITH STOCHASTIC PROCESSES

(L. C. Card No. Mic 60-1262)

Alfred Edward Garratt, Ph.D. Virginia Polytechnic Institute, 1958

A brief introduction to the concepts and terminology of spectral analysis and a review of the standard methods for cross-spectral estimation, based on discrete timehistory data, are incorporated in Chapter 1.

Co-spectral and quadrature-spectral estimators which are characterized by non-negative spectral windows are developed in Chapter 2. While the spectral windows for the co-spectral estimators are non-negative for all relevant values of the assignable constants, certain restrictions on these constants are necessary to assure the non-negativity of the quadrature-spectral window. The properties of these estimators are considered in detail.

In Chapter 3 randomized co-spectral and quadrature-spectral estimators are presented. These estimators depend on the random selection of sets of time differences, as opposed to the systematic evaluation of all possible time differences for the standard estimators. By suitable choices of probability distributions for the time differences and of weight functions, the expectations of the randomized estimators can be made equivalent to the expectations of the standard estimators or the estimators of Chapter 2. Since the randomized estimator is much simpler to use than the standard estimator, these estimators are compared in terms of their variances, given

that they have equal expectations. The choice of probability distributions to yield minimum variance, given that the expectation is specified, is considered.

Extremely simple co-spectral and quadrature-spectral estimators, for the case where the coefficients of the Fourier series expansions of realizations of the processes over a finite time interval can be obtained by means of suitable analog equipment, are developed in Chapter 4. The expectations, variances and covariances of these estimators are derived.

Microfilm \$2.50; Xerox \$5.00. 96 pages.

THE APPROXIMATION OF SOLUTIONS OF NON-LINEAR DIFFERENTIAL EQUATIONS

(L. C. Card No. Mic 60-1474)

Melvin D. George, Ph.D. Princeton University, 1959

Let K be a non-linear operator in a Banach space X and K(h) a family of bounded non-linear operators such that for x in the domain of K, K(h)x \rightarrow Kx as h \rightarrow O. If we let A(h) = I + hK(h), then the main result gives sufficient conditions for the convergence of Aⁿ(h)x to T(t)x as n $\rightarrow \infty$, nh \rightarrow t, where T(t) is a given semigroup in a restricted sense which is the solution for t $\leq \tau$ of the non-linear initial-value problem in X, $\frac{dT(t)x}{dt} = KT(t)x$, T(O)x = x

The major condition is that the Frechet differential of A(h) must be bounded by 1 on a certain subset of X, and this condition is shown to be a generalization of the notion of stability which plays a central role in the corresponding theorem in the linear case.

A class of non-linear initial-value problems is investigated and their solutions shown to have the properties required by the convergence theorems. Finally, the main result is applied to the approximation of solutions of non-linear differential equations by solutions of finite-difference schemes.

Microfilm \$2.50; Xerox \$3.00. 49 pages.

PRO-ALGEBRAIC STRUCTURE ON THE RATIONAL SUBGROUP OF A P-ADIC ABELIAN VARIETY

(L. C. Card No. Mic 59-5181)

Marvin J. Greenberg, Ph.D. Princeton University, 1959

We prove the following theorem: If A is an Abelian variety over a p-adic field K with non-degenerate reduction

mod \underline{p} , then any principal homogeneous space of A over K which does not have a rational point in K cannot have a rational point in any unramified extension of K. In the course of the proof, we shed new light on the group A_K of rational points of A over K by showing that it is a projective limit of group varieties over the residue field of K. The method of constructing these group varieties can be generalized to yield a new functor from algebraic spaces over an arbitrary local domain R to a projective system of algebraic spaces over the residue field of R. Microfilm \$2.50; Xerox \$3.00. 47 pages.

ON AUTOMORPHISMS OF A SPLITTING EXTENSION $G = (H, K; \phi)$.

(L. C. Card No. Mic 60-1398)

Nai-chao Hsu, Ph.D. Washington University, 1960

Chairman: Franklin Haimo

This study deals with automorphisms of a splitting extension $G = (H, K; \phi)$, where H and K are groups and where ϕ is a homomorphism of K into the automorphism group of H. The term "a splitting extension $G = (H, K; \phi)$ " refers to the group consisting of all ordered pairs (h, k), $h \in H$, $k \in K$, with the multiplication

 $(h, k)(h', k') = (h\phi_k(h'), kk').$

G is often simply called a splitting extension of H by K. In case ϕ is a monomorphism, G is nothing but a relative holomorph of H with respect to $\phi(K)$. For this case, we have the following generalization of Yu. A. Gol'fand's result (On the group of automorphisms of the holomorph of a group, Rec. Math. (Math. Sbornik) N. S. vol. 27 (69) (1950) pp. 333-350).

1. Under a certain condition, the group of all automorphisms of G each of which maps H onto itself is isomorphic to a splitting extension of the group of regular crossed characters of $\phi(K)$ into H by the normalizer of

\$\phi(K)\$ in the automorphism group of H.

2. Under a certain condition, the inner automorphism group of G is isomorphic to a splitting extension of a certain subgroup of the group of regular crossed characters of $\phi(K)$ into H by a certain group lying between $\phi(K)$ and the normalizer of $\phi(K)$ in the automorphism group of H.

3. Under a certain condition, the factor group of the group of all automorphisms of G each of which maps H onto itself modulo the inner automorphism group of G is isomorphic to the factor group of the group of regular crossed characters of $\phi(K)$ into H modulo the subgroup thereof mentioned in 2.

Gol'fand's theory, generalized as well as original, is used to discuss automorphisms of a relative holomorph as well as of the holomorph of some uncomplicated groups.

The principal findings are as follows:

1. Let G be the holomorph of a complete group H which can not be isomorphic to any of its proper subgroups. Suppose that the square of the index of any non-trivial normal subgroup of H is less than the order of H. Then, every automorphism of G which maps H onto itself

is inner, and the automorphism group of G is a splitting extension of the inner automorphism group of G by a group of two elements.

2. Let G be a relative holomorph of an abelian group

H with respect to an abelian group $\phi(K)$.

2a. A sufficient condition has been found under which the group of all automorphisms of G each of which maps H onto itself is isomorphic to G.

2b. A sufficient condition has been found under which the inner automorphism group of G is isomorphic to G.

2c. A sufficient condition has been found under which the group of all automorphisms of G each of which maps H onto itself is a splitting extension of the inner automorphism group of G by a group of two elements.

As applications of our results, the automorphism group of the holomorph of a symmetric group of degree $n \ge 3$, $n \ne 4$ and $n \ne 6$ and the automorphism group of the holomorph of a non-zero subgroup of the additive group of rational numbers can be determined.

Microfilm \$2.50; Xerox \$4.40. 83 pages.

ULTRAFILTERED PRODUCTS AND ARITHMETICAL EXTENSIONS

(L. C. Card No. Mic 60-1476)

Simon Kochen, Ph.D. Princeton University, 1959

The concept of an ultrafiltered product of a set $\{\mathcal{O}_i \mid i \in I\}$ is introduced. This is a quotient system of the direct product $\prod_{i \in I} \mathcal{O}_i$ under a congruence relation

induced by an ultrafilter in I. In the Stone space of the Boolean algebra of arithmetical classes, the formation of all ultrafiltered products of the \mathcal{O}_i yields the closure set of the set-of-points corresponding to the \mathcal{O}_i . If $\mathcal{O}_i = \mathcal{O}_i$, then the ultrafiltered products are arithmetical extensions of O. Many well known results in logic are proved by this method. A filtration system is a subset of the direct product which yields as quotient systems (under certain congruence relations) systems which share many of the properties of ultrafiltered products. Various rings of continuous functions are proved to be filtration systems. This yields a class of continuity transforms. Free filtration systems, which yield all arithmetical extensions of a given system, are constructed. This is applied to proving a representation theorem for Herbrand functions over algebraically closed fields.

Microfilm \$2.50; Xerox \$5.40. 109 pages.

THE EFFECT OF STUDENT CONSTRUCTED
ASSIGNMENTS ON CERTAIN FACTORS IN
MATHEMATICAL ACHIEVEMENT AND RETENTION

(L. C. Card No. Mic 60-1090)

Sister Rose Marian Mulligan, O.S.F., Ph.D. New York University, 1959

Statement of the Problem

The problem of this study was to determine the effect of student-constructed assignments on achievement in the algebraic content of an introduction to mathematics course and the effect which these assignments have on the retention of algebra content, algebraic problem solving ability, and critical thinking by freshmen liberal arts college students.

Plan of the Study

In solving the problem of this investigation it was necessary:

- 1. To equate the groups on the basis of general achievement and mathematical proficiency.
- 2. To initiate, develop, and administer a program of student-constructed assignments on the basis of content, selection of related material, and recognition of level of correct procedure.
- 3. To relate semester gains in problem solving and critical thinking to initial results in the same areas.
- 4. To investigate the extent to which the experimental group benefited by student-constructed assignments in relation to algebraic subject matter found in the prescribed course and to compare the results with the control group.
- 5. To compare both groups with respect to the retention of knowledges, skills, algebraic problem solving, and critical thinking four months following the termination of the formal teaching of the algebra content in the course.

Procedure

The students who participated in this study were twenty-two students of the 1956-1957 freshman class at Ladycliff College, Highland Falls, New York; acting as the experimental group and nineteen students of the 1956-1957 class at Good Counsel College, White Plains, New York acting as the control group.

In order to discover the effect which student-constructed assignments in an introduction to mathematics course had on achievement and on the retention of problem solving ability, critical thinking and algebra content, the investigator made use of the experimental method. At the beginning of the term, the American Council on Education Psychological Examination for College Freshmen, and the Cooperative General Achievement Test, Mathematics, were administered at both institutions. The achievement level and mathematical proficiency level were determined from the total scores of both groups. The mean difference when tested was found to be insignificant.

Both classes were taught by the lecture-demonstration method. The variable factor, the student-constructed assignments numbering twenty-one, was used in the first semester with only the experimental group. At the close of each unit every pupil in the experimental group composed an assignment on the material suggested by the instructor. One student compiled the assignment, a second worked it, while a third checked and evaluated it according to check lists compiled by the students and the instructor.

A standardized test on algebra content and problem solving was administered to both groups to test achievement in subject matter and ability in problem solving.

The Watson-Glaser Critical Thinking Appraisal Test was also given at this time to both groups.

The same tests in algebra content, problem solving and critical thinking were re-administered in May to both groups to test for retention four months after instruction in algebra had been completed.

Summary and Conclusions

The major conclusions drawn from the study may be summarized as follows:

- The students in this study do not differ significantly initially in any category under discussion and are representative of all United States female freshmen students in four-year colleges of women. Their mathematical achievement in particular is representative of the freshmen in other colleges.
- 2. At the end of the first semester there was a statistically significant difference in algebraic subject matter and problem solving ability in favor of the experimental group. After four months elapsed time the experimental group also showed greater retention of these abilities.
- 3. Although both groups showed a highly significant increase in critical thinking ability over their initial ability, there was no appreciable difference between them at the end of the first semester. The experimental group, however, sustained a greater loss in retention over a four month period.

Microfilm \$3.40; Xerox \$11.95. 262 pages.

SONIC LIMIT SINGULARITIES IN THE HODOGRAPH METHOD

(L. C. Card No. Mic 59-3024)

Steven Henry Schot, Ph.D. University of Maryland, 1958

Supervisor: Associate Professor Geoffrey S. S. Ludford

In the hodograph transformation, introduced to linearize the equations governing the two-dimensional inviscid potential flow of a compressible fluid, there may appear so-called limit-points and limit-lines at which the Jacobian $I = \frac{\partial(x,y)}{\partial(q,\theta)}$ of the transformation vanishes. This thesis investigates these singularities when they occur at points or segments of arc of the sonic line (Mach number unity).

Assuming the streamfunction to be regular in the hodograph variables, it is shown that sonic limit points cannot be isolated but must lie on a supersonic limit line or form a sonic limit line [cf. H. Geiringer, Math. Zeitschr.,

63, (1956), 514-524]. Using this dichotomy a classification of sonic limit points is set up and certain geometrical properties of the mapping in the neighborhood of the singularity are discussed. In particular the general sonic limit line is shown to be an equipotential and an isovel; an envelope of both families of characteristics; and the locus of cusps of the streamlines and the isoclines. Flows containing sonic limit lines may be constructed by forming suitable linear combinations of the Chaplygin product solutions for any value of the separation constant $n \ge 0$. For n less than a certain value no and greater than zero (n = 0 corresponds to the well-known radial flow), these flows represent a compressible analogue of the incompressible corner flows and may be envisaged as taking place on a quadruply-sheeted surface. The sheets are joined at a supersonic limit line and at the sonic limit line which has the shape of a hypocycloid (n > 1), cycloid (n = 1), or epicycloid (n < 1). To exemplify the general behavior, the flows are constructed explicitly for $n = \frac{1}{2}$, 1, and 2. The shape of the sonic limit line is also discussed when solutions corresponding to different n are superposed, and it is shown how then the supersonic limit line can be eliminated so that an isolated sonic limit line is obtained. A flow containing such an isolated sonic limit line is presented. An appendix derives the asymptotic solution for large values of n which corresponds to the sonic limit solution.

The above results have been published in part in Math. Zeitschr., 67, (1957), 229-237. Other portions of this thesis will appear in two papers in Archive Rational Mech. and Anal., 2, (1958).

Microfilm \$2.50; Xerox \$4.00. 73 pages.

SUMMABILITY C OF SERIES OF SURFACE SPHERICAL HARMONICS

(L. C. Card No. Mic 60-1452)

Aaron Siegel, Ph.D. Rutgers University, 1960

Major Professor: Dr. Victor L. Shapiro

This paper presents necessary and sufficient conditions $\underline{\infty}$

for the Cesaro summability of a series $\sum_{n=0}^{\infty} Y_n(Q)$ of

surface spherical harmonics defined on the surface Ω of the unit sphere. Analogous work was done by Plessner [2, p. 256] in the field of Trigonometric series. A definition of the r'th Generalized Derivative of a function given by de la Vallee-Poussin [1] was critical for the work in Trigonometric series. This paper gives a definition of the r'th Generalized Laplacian, $r=0,1,2,\ldots$, at a point P of a function f(Q) defined on $\Omega(\text{denoted }\Delta_r f(P))$, which is instrumental in obtaining the results.

It also includes a sufficiency theorem for the Cesaro summability of formally "differentiated" Laplace Series.

The three main theorems of this paper are the following: Let f(Q) be a bounded Borel measurable function

defined on Ω . Let $\sum_{n=0}^{\infty} Y_n(Q)$ be an arbitrary series of

surface spherical harmonics. Let S[f(Q)] denote the Laplace series of f(Q), and let $\Delta^{(r)}\{S[f(Q)]\}$ be the term-by-term "Laplacian" of S[f(Q)]. Let $F(Q) \equiv$

$$\begin{cases} \Delta(-r) & \left\{ \sum_{n=0}^{\infty} Y_{n}(Q) \right\} \equiv \sum_{n=0}^{\infty} Y_{n}(Q) & r=0 \\ \\ \Delta(-r) & \left\{ \sum_{n=0}^{\infty} Y_{n}(Q) \right\} \equiv (-1)^{r} & \left\{ Y_{0} \left[\frac{Pr([P,Q])}{[r(r+1)]^{r}} \right] \right. \\ \\ & + \sum_{n=1}^{\infty} \frac{Y_{n}(Q)}{[n(n+1)]} r \right\} n = 1,2,- \end{cases}$$

Theorem 1: If $\Delta r f(P)$, r = 0,1,2,..., exists then $\Delta^r \{S[f(Q)]\}$, r = 0,1,2,..., is at the point P, $(C - \alpha)$ summable, $\alpha > 2 r + 1$ to $\Delta_r f(P)$.

Theorem 2: Let $Y_n(Q) = 0(n^k)$ uniformly on Ω , for some k. If there exists an integer $r \ge 0$ such that when we form

F(Q), Δ_r F(P) exists, then the series $\sum_{n=0}^{\infty} Y_n(Q)$ is at the point P, (C- α) summable, $\alpha > 2r + 1$, to Δ_r F(P).

Theorem 3: Let $\sum_{n=0}^{\infty} Y_n(Q)$ with $Y_n(Q) = 0(n^{\alpha})$ uniformly on Ω , be $(C-\alpha)$ summable, $\alpha = 0,1,2,\ldots$, to s at a point P on Form F(Q) with r an integer greater than $\frac{\alpha+2}{2}$. Then $\Delta_r F(P)$ exists and equals s.

Necessary and Sufficiency Theorem: Let $Y_n(Q) = O(n^{\gamma})$ uniformly on Ω , for some γ . Then a necessary and suf-

ficient condition that $\sum_{n=0}^{\infty} Y_n(Q)$ be Cesaro summable to

s at a point P on Ω is that there exist an integer $r \ge 0$ such that $\Delta_r F(P)$ exists and equals s.

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- 1. DE LA VALLEE-POUSSIN, "Sur l'approximation des functions d'une variable reele," <u>Bull. de l'Academie royale de Belgique</u> 1908, 193-254
- 2. ZYGMUND, ANTONI. Trigonometrical Series, New York, Chelsea Publishing Co. 1st Edition 1935
 Microfilm \$2.50; Xerox \$5.40. 106 pages.

GROUPS AND ALGEBRAICITY IN COMPLETE RANK RINGS

(L. C. Card No. Mic 59-6289)

Robert James Smith, Ph.D. The University of Tennessee, 1959

Major Professor: J. A. Cooley

The class of complete rank rings consists of (i) the matrix rings over arbitrary division rings and (ii) the continuous rings of von Neumann. Theorem. In a continuous ring the closure of the commutator subgroup of

the group of invertible ring elements is the unit group itself. The argument consists of an extension of Dieudonné's method for his theory of a determinant of an

invertible matrix over a division ring.

Ore's determinantal theory for matrices is extended to members of a general complete rank ring. An Ore determinant is defined for λ -matrices of any matrix $A = (a_{ij})$ of order two or three over an arbitrary division ring. "Characteristic equations" satisfied by A are obtained by equating to zero the Ore determinant of AI-A when (i) the order of A is two and (ii) the order of A is three provided some $a_{ij} = 0$ ($i \neq j$). The equations found are non-unilateral.

Unproven statements of von Neumann on the algebraicity over the center Z of the ring of members of a general complete rank ring are established. In particular, if t belongs to a complete rank ring, R, then for a unique idempotent e in \mathbb{R} , we have a decomposition t = ete +(1-e)t(1-e) where (i) p(ete) has an inverse in e Re for every polynomial p(x) with coefficients in Z and (ii) p((1-e)t(1-e)) can be made arbitrarily close to zero in the rank-distance topology of R for a suitable polynomial p(x) with coefficients in Z.

Microfilm \$2.50; Xerox \$4.40. 82 pages.

THE EFFECT OF INTEREST-CENTERED "TAKE-HOME TESTS" ON LEARNING IN ELEMENTARY ALGEBRA

(L. C. Card No. Mic 60-1099)

Sister Mary Denis Treacy, O.S.F., Ph.D. New York University, 1959

Statement of the Problem

This is an experimental investigation to discover what part "take-home tests" based on individual interests play in the development of problem solving ability, critical thinking, and general efficiency in elementary algebra.

Plan of the Study

In order to ascertain the information pertinent to this investigation, it was necessary:

- 1. To equate the groups on the basis of mental ability and algebraic achievement.
- 2. To discover the categories into which the interests of the experimental group fell.
- 3. To construct, validate, and test for reliability "takehome tests" based on an analysis of the results of an achievement test in algebra and on the interest categories.
- 4. To discover whether those who were given conventional tests or those who were given the interestcentered "take-home tests" did better in mathematical efficiency from testing to testing on the periodic tests.
- 5. To discover the effect interest-centered "take-home tests" had on problem solving ability, critical thinking, and general efficiency in elementary algebra.

Procedure

This study was conducted at a four-year girls high school in Newburgh, New York during the academic year 1956-1957. There were thirty-three freshmen in the experimental group and thirty freshmen in the control

In January 1957, for the purpose of equating the groups, three tests were administered to all students enrolled in the elementary algebra course. They were (a) the Terman-McNemar Test of Mental Ability, (b) the Seattle Algebra Test, and (c) the Watson-Glaser Critical Thinking Appraisal. The Kuder Preference Record Vocational was administered to the experimental group.

Every five weeks the control group was given a conventional test administered within a class period and the experimental group was given the interest-centered "takehome test" to be completed and returned within a period of ten days. These interest-centered "take-home tests" consisted of eight remedial examples based on an analysis of the results of the Seattle Algebra Test and twenty-two problems based on course content adapted to the special interests of the students as ascertained by the results of the Kuder Preference Record Vocational.

In June the Watson-Glaser Critical Thinking Appraisal was readministered to determine what changes had taken place in critical thinking in both groups. The Lankton Algebra Test was also administered to test course content.

Summary of Findings and Conclusions

The initial data presented evidence of the equality of the groups as to mental ability, algebraic achievement, problem solving, and critical thinking. These groups were representative of the general population.

The experimental group had a higher mean in all three "take-home tests" than the control group had in conventional tests. This difference proved significant in only

one instance.

In critical thinking the control group had a slight but insignificant initial advantage. In June the mean difference remained insignificant but both showed an increase in this ability. The experimental group profited more from testing to testing than did the control.

It was concluded that the interest-centered "take-home tests" did not have any appreciable effect upon general efficiency in elementary algebra nor did they have any marked effect upon the students' ability to solve problems.

The results of this experiment were unexpected. Previous research seemed to indicate that where interests were considered greater progress was made by the students. Microfilm \$3.00; Xerox \$10.35. 229 pages.

MULTIPLIERS OF COMMUTATIVE BANACH ALGEBRAS

(L. C. Card No. Mic 60-1377)

Ju-kwei Wang, Ph.D. Stanford University, 1960

We are concerned with commutative Banach algebras A in which xA = 0 implies x = 0. A multiplier of A is a mapping T: A - A satisfying xTy = Tyx. The multipliers of A are bounded linear operators and they form a

commutative algebra M(A), called the multiplier algebra of A. M(A) is complete under the strong operator topology. A can be algebraically embedded in M(A) as an ideal.

When A is semisimple, M(A) is also semisimple; and the maximal ideal space of A can be embedded in that of M(A).

If A is a supremum norm algebra, so is also M(A). In this case there are three natural topologies for M(A), namely, the norm topology σ , the strong operator topology β and the compact-open topology κ each being stronger than the following one. σ and β are equivalent if and only if A has compact Silov boundary. Under suitable assumptions, B and κ are equivalent if and only if every countable union of compact subsets of the Silov boundary of A has a compact closure.

The multiplier algebras of several interesting special algebras are exhibited at the end of the paper.

Microfilm \$2.50; Xerox \$3.00. 40 pages.

ON TIME SERIES ANALYSIS AND REPRODUCING KERNEL SPACES

(L. C. Card No. Mic 60-1380)

Nils Donald Ylvisaker, Ph.D. Stanford University, 1960

Let $X(\cdot)$ be a (real valued) continuous parameter process on an underlying probability space (Ω, \mathcal{Q}, P) satisfying the conditions

$$\int X(s)dP = 0 \text{ for all real } s,$$

$$\int X(s) X(t)dP = k(s-t) \text{ for all } s \text{ and } t,$$

the function k is continuous at the origin.

A Hilbert space H is said to be a representation of the process if H is isomorphic to the span of the family $\{X(s), s \in E_1\}$ in the (real) L_2 space associated with the measure P. The paper studies the reproducing kernel space representation of the process $X(\cdot)$.

A reproducing kernel space H(K, T) is a Hilbert space

of functions defined on some set T, generated by a positive definite kernel K on T X T. The defining properties are

for every
$$t \in T$$
, $K(.,t) \in H(K, T)$

for every
$$f \in H(K, T)$$
 and $t \in T$, $(f,K(.,t)) = f(t)$.

The representation of the process $X(\cdot)$ considered is the reproducing kernel space associated with the kernel K defined on E_2 by

(3)
$$K(s, t) = k(s-t)$$
 for all real s and t.

Section 2 of the paper is devoted to a review of some basic theorems of general reproducing kernel space theory. Special emphasis is given to the reproducing kernel spaces associated with kernels K of the form (3). In this context, the realization of the group of unitary operators in $H(K, E_1)$ is obtained. The properties of functions in $H(K, E_1)$ are considered relative to the properties of the kernel itself, and in particular, a sufficient condition is given that $H(K, E_1)$ be composed of quasi analytic functions.

Section 3 treats the concept, introduced by Kolmogorov, of processes subordinate to a given process.

A definition of subordination is given, which is shown to be equivalent to that of Kolmogorov. The reproducing kernel space associated with a subordinate process is characterized relative to the reproducing kernel space associated with the original process. The notion of mutual subordination is considered and two special forms of subordination are noted.

The final section is devoted to the linear extrapolation problem for the process X(·). In particular, the usual prediction problem is discussed relative to the reproducing kernel space representation. The induced classification of processes into deterministic, non-deterministic, and regular non-deterministic processes is then characterized in the representation. Sufficient conditions are given that a process subordinate to a deterministic (regular non-deterministic) process be itself deterministic (regular non-deterministic). Lastly, a subordinating operation is demonstrated for which the corresponding subordinate process is deterministic and mutually subordinate with the original process.

Microfilm \$2.50; Xerox \$3.00. 48 pages.

MUSIC

THE TRIO SONATAS OF ANTONIO CALDARA. (VOLUMES I AND II).

(L. C. Card No. Mic 60-1403)

Marysue Barnes, Ph.D. The Florida State University, 1960

Antonio Caldara (1670-1736) was one of the most creative and highly esteemed composers of his day. Hundreds of his extant works attest to a richly productive career. These works include operas, oratorios and other sacred

works, and instrumental compositions of various kinds, especially trio sonatas. His earliest compositions led to his recognition by Charles VI of Vienna who appointed him Vice-Kapellmeister under the great Johann Josef Fux. For twenty years these two composers dominated the musical scene during the most brilliant period of the Viennese court.

Instrumental practice during much of the seventeenth century was characterized by experiment and diversity. Many facets of the development of instrumental style remain obscure. It is the purpose of this study to illuminate

those developments to which Antonio Caldara contributed, especially in his trio sonatas, Opus 1 (1693) and Opus 2 (1699). The study is composed of two volumes, the first an historical and analytical inquiry, the second a modern edition of fifteen selected trio sonatas.

The first two chapters of Volume I present a brief summary of the evolution of the trio sonata and a biographical account of Caldara's musical activities. The remaining chapters are devoted to close examination of Caldara's instrumental trio style. Caldara's trio compositions appeared after the salient features of the trio sonata were well-established; thus, in his composition of Opus 1 and Opus 2 he was free of the necessity of inventing containing forms and was able to devote his full ingenuity to the development of his individual style. Volume II presents in modern edition six sonatas da chiesa from Opus 1 and nine sonatas da camera from Opus 2. Sources and editorial procedures are described in Volume I.

The trio sonatas of Caldara show a composer wellinformed of contemporary practices and well-disciplined in contrapuntal craft. The sonatas da chiesa are the more serious compositions in which Caldara displays his full mastery of counterpoint. Despite some occasional pedantry, these are the best of Caldara's sonatas. The sonatas da camera feature occasional contrapuntal movements but are chiefly comprised of dance movements following patent forms. The da camera style is distinctly lighter, occasionally naive, but never prolonged to dullness. These compositions are representative of large numbers of such works produced during the period. Undoubtedly, many of them were performed for the diversion of royal patrons. In modern performance these sonatas are still entirely satisfying as diversions. Moreover, they convey a considerable insight into the period of their creation -- a period of experiment, discovery, crystallization of instrumental technique, and above all, a period of anticipation of the works of Bach and Handel.

Microfilm \$6.50; Xerox \$22.95. 509 pages.

PROBLEMS OF MUSIC APPRECIATION
TEACHING AS PERCEIVED BY STUDENTS
AND TEACHERS IN NORTHERN CALIFORNIA
COLLEGES AND JUNIOR COLLEGES

(L. C. Card No. Mic 60-1345)

Meyer Martin Cahn, Ed.D. Stanford University, 1960

Statement of the Problem:

The problem of this study concerns an examination of music appreciation teaching behavior at the college level. The purpose is to determine and define major teaching problems as perceived by college students and instructors. The study examines: 1) teaching behaviors which students and teachers find most effective and ineffective, 2) areas of greatest agreement and disagreement, 3) the literature of music appreciation teaching as it relates to these perceptions.

Procedure:

To determine these problems, two steps were taken: first, student and teacher perceptions of effective teaching

were obtained and compared; second, these perceptions were referred to the literature of music appreciation teaching. Underlying agreements and differences were studied.

Data were obtained by means of the critical incident technique of Flanagan. Subjects consisted of 523 music appreciation students from six junior colleges and six four-year colleges in Northern California, and 38 music appreciation instructors in the same area. Classroom incidents describing effective and ineffective teaching behavior as perceived by students were collected by group interview. Similar data were obtained by personal interview from instructors. From a total of 1116 incidents, 2377 behaviors were extracted and organized into categories and sub-categories. These were reviewed by two outside observers. Rank orders of student and teacher responses were then compared using the Spearman rank difference correlation coefficient.

Results:

Tables are presented in the study which list the frequency of response for both students and teachers for each of 102 behaviors extracted from critical incident interviews. Effective behaviors, ineffective behaviors and perceived competencies (which combine effective and ineffective behaviors) are tabulated and their rank orders are compared.

In addition, data were organized into twelve major categories, and through these the literature was approached. These categories included the selection of music, selection of relevant background materials, lecture techniques, use of audio-visual aids, use of student contributions, presentation of musical examples, testing and evaluation, professional qualifications of the instructor, relations with individual students and class, and instructor's personal characteristics. The frequency of student and teacher response for each of these categories was also tabulated and their rank orders were compared.

The coefficient of correlation for these twelve categories is .51, significant at the 10% level. The rho for students and teachers for the entire 102 perceived competencies is .65, significant at beyond the 1% level. Thus one may conclude a fair degree of similarity of response between students and teachers of the study. A high degree of difference is also implied by these figures.

Conclusions:

- 1. Students showed greater concern than faculty for simplification procedures, examinations, biographical content, as well as musical experiences that would satisfy present levels of understanding. Faculty were more concerned with music designed to raise students' level of understanding and with pedagogical activities that bring students into closer contact with music being studied. Because these perceptual differences affect teaching efficiency, further study is needed to determine how they may be minimized. Meanwhile, an important step can be taken if faculty will show awareness of students' need for simplification and clarity in the selection and presentation of musical materials.
- 2. The study provides one answer to those who raise serious doubts concerning the definition of the role of the music appreciation teacher. Areas of agreement between students, and teachers, and corroborated by writers, provide a tentative but reasonable basis for determining,

in part, how that role shall be played. His role is that of a good teacher; he uses current learning theory, particularly in relating instruction to students' present and expanding abilities, interests, background, attitudes, knowledge and skills.

3. The results of the study raised some questions about the pertinancy of relationships between certain teaching practices and musical or aesthetic objectives. This was noted particularly in certain uses of audio-visual aids, student contributions, correlative techniques, biographical content, testing, and procedures leading to enhancement of listening skills. Until further studies provide reliable and more direct routes toward musical growth, the music appreciation teacher must be on the alert to minimize deviations from his central purposes.

4. Conscious and more frequent use of non-verbal teaching procedures may enhance music appreciation teaching effectiveness. The use of musical repetition, of comparisons, and of devices which present musical concepts by relating them to sensory experiences such as sight, shape and movement offer an opportunity to minimize obstacles of terminology and to deal more directly with musical values.

Microfilm \$3.50; Xerox \$12.15. 270 pages.

THE MASSES OF ANTOINE DE FÉVIN.
[VOLUMES I AND II].

(L. C. Card No. Mic 60-1418)

John F. Spratt, Ph.D. The Florida State University, 1960

The number of masses attributable to Antoine de Févin (circa 1475-1511) is considered by the author to be ten. These have been transcribed, from the best available manuscript and printed sources of the sixteenth century, into modern notation; and have been provided with a commentary wherein the author has not only noted characteristic features of the composer's style but has attempted to assess the merit of Févin's music in terms of a basic axiological system. Févin's music has therefore not been exclusively or chiefly compared with that of his contemporaries, but rather seen in the perspective of Western art music as a whole, and in the light of abstract principle wherever possible. The results, based on a correlation of musicological and philosophical opinions, do not differ radically from previous estimates of Févin's work, but simply attempt to make such judgments more explicit and hence more generally applicable.

Microfilm \$7.20; Xerox \$25.65. 568 pages.

PHARMACOLOGY

SOME PHARMACOLOGIC PROPERTIES OF SELECTED CENTRAL SYMPATHETIC DEPRESSANTS

(L. C. Card No. Mic 60-1551)

William James Fleming, Ph.D. State University of Iowa, 1960

Co-chairmen: Professor Hugh H. Keasling and Associate Professor John P. Long

The results of a comparison made between 8-methoxyand 8-ethoxybutamoxane (8-alkyloxy-2-butaminomethyl-1,4-benzodioxane) and chlorpromazine are reported. The rabbit tooth pulp threshold method and a modification of the D'Amour-Smith method were experimental analgetic tests utilized for this study.

All three agents caused an elevation of the tooth pulp threshold in rabbits, but none of the compounds prolonged reaction time when tested by the tail-flick method in rats. When varying doses of the test drugs were administered in combination with a fixed dose of morphine sulfate and tested by the latter method, it was found that the butamoxanes tended to antagonize the analgetic activity of morphine, while chlorpromazine prolonged and intensified morphine activity.

Results from experiments undertaken in an attempt to elucidate some of the observed differences are reported and possible explanations for these discrepancies are discussed. Microfilm \$2.50; Xerox \$3.00. 34 pages.

PHILOSOPHY

ACTION AND THE WILL (L. C. Card No. Mic 60-1351) Daniel Clark Bennett, Ph.D.

Stanford University, 1960

There is more than one notion of voluntary action which is philosophically interesting. Two are of pre-eminent

interest; the one which is bound logically to the notion of responsibility; the other which is bound logically to the notion of reasons for acting. The second of these is logically prior, and demands clarification independently of the first.

Certain philosophical theses concerning the nature of action fail to distinguish these two notions of voluntary action, with the result that they give an inaccurate characterisation of the prior notion, and an inaccurate delimitation of the nature of the sorts of things of which the prior notion and the notion of action simpliciter can be significantly predicated. Thus, H. L. A. Hart argues that the notion of action simpliciter is a fundamentally non-descriptive concept, because in saying of someone that he did something one is (often) ascribing responsibility to him, and, A. I. Melden argues that the notion of action is bound logically to the notion of following or observing rules. Both these views limit the notion of action to creatures who are capable of being responsible or following rules, that is to men, and thus, virtually, identify the notion of voluntary action which is bound to the notion of responsibility, and the notion of voluntary action which is bound to the notion of reasons for acting.

The sort of reasons for acting in terms of which the prior notion of voluntary action is to be understood fall within the class a sufficient condition of membership in which is the following: they are mentioned in psychological reports which are not based on evidence, or criteria, or observation (Wittgenstein). It is possible to isolate three sorts of reasons in this class of reasons for acting: purposes in acting, motives (including both states of character and states of mind), and occasions. Any act which is done with a view to an end, i.e. in doing which there is some purpose, is voluntary. Furthermore, occasions and motives, when they are reasons for acting voluntarily, involve some purpose in acting. Thus, a voluntary action, which is an action for which there is a reason of a certain sort, is an action which is done with a view to an end.

Wittgenstein has shown that phenomena like purposing are not events, acts, or processes, and that such phenomena can not be said to be known to the person of whom they are accidents in the way in which non-mental accidents may be said to be known to him. Wittgenstein's arguments to show that such phenomena can not be referred to, however, depend upon an unacceptable restriction on reference, i.e., that it involve direct identification of the thing referred to. Furthermore, sense can be given to a notion of knowledge of purposes which avoids Wittgenstein's arguments, and which accommodates the Freudian notion of an unconscious purpose. This notion of knowledge is bound up with the notion of acknowledging or admitting to oneself; an unconscious purpose being one which one does not acknowledge or admit to oneself.

Microfilm \$3.45; Xerox \$12.15. 267 pages.

SOME FUNCTIONAL THEORIES OF RELIGION AND THEIR PHILOSOPHICAL BASES: AN ESSAY IN THE INTEGRATION OF PHILOSOPHY, RELIGION AND SOCIAL SCIENCE.

(L. C. Card No. Mic 59-6296)

Robert Charles Browne, Ph.D. Syracuse University, 1959

Supervisor: Harmon H. Bro

The functional theories of religion of such psychologists, sociologists, and anthropologists as Freud, Kardiner, Malinowski, Durkheim, Parsons, Davis and Yinger, point

to a use of religion which may be called "compensatory." That is, these psychologists and social scientists demonstrate how religion may function to provide comfort, consolation, tension reduction and assuagement of anxiety in the face of the discomforts, privations, pains, anxieties, and sufferings of life. And they further show how, as a by-product of this function for the individual, religion also functions to promote the solidarity, cohesiveness and stability of society.

The theories of Fromm and Jung, on the other hand, indicate that religion, in addition to having a compensatory function, may also function in some instances in a "regenerative" way. That is, it may bring about man's "renewal" or "rebirth" in the sense of liberating his energies from their usual repressive, infantile, and projective investments. Thus, religion can have either of two major kinds of functions—compensatory or regenerative. Which one it will have is determined by the total configuration of the religious symbol system, the institutional setting, and the psychological structures of the individual involved.

The case of Zen is provided as an illustration of the regenerative functioning of religion, and it is followed by an analysis showing the capacity of Jungian-Frommian theory to account for such functioning. Since the theories of Jung and Fromm take account not only of the compensatory function of religion, but also of its regenerative function, they may be said to have theoretical superiority. This theoretical superiority stems most fundamentally from their initial assumptions as to the nature of man.

The theories of Freud, Kardiner and Parsons describe man as a creature of "needs" or "drives" who is thus motivated in terms of improving a pleasure-pain or gratification-deprivation balance. Underlying such premises is the assumption of a dualistic or subject-object epistemology. By assuming a dualistic epistemology, the observation of man's nondual experience is screened out. Man becomes described solely in terms of his responses to an object-world. He becomes identified with his responses—his thoughts, feelings, sensations, and desires. And an observation of man only in terms of these responses to an object-world sees him as driven by his inclinations toward the pleasurable and his aversion to the painful. Hence the theories of "drives" and the formulation of theoretical first premises such as the pleasure principle.

The theories of Jung and Fromm, on the other hand, while taking account of the dualistic mode, rest fundamentally on the assumption of a nondual ground of man's existence. Thus, they do not selectively eliminate nondual experiences from their observations, or screen out "spontaneous" and "autonomous" acts, or behavior which is not motivated in terms of an improvement of a gratificationdeprivation balance. Instead, they include such action and behavior in their accounts, and encompass that range of man's experience which is "liberated," "productive," and "individuated." Thus, their theoretical formulations can be said to be more comprehensive because, being grounded on nondual existential assumptions, they are able to indicate more fully the total range of human experience. While they understand that man is largely a creature driven by needs, cravings, and desires, they are not left utterly confuted when, out of the power which resides in the ontological depths of his being, man transcends himself in acts of compassion and creativity which burst the bonds of all selfhood that is less than the world. They know how it should be that kairos, the eternal instant of time fulfilled

and the going out of self altogether, is simultaneous with the moment when Self contains the cosmos. This is a paradox, but what is important is that it is, and therefore must be indicated by any theory which attempts to speak of man and his religion.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

THE MORAL ENVIRONMENT OF JACOBEAN TRAGEDY

(L. C. Card No. Mic 60-1412)

Taylor D. Littleton, Ph.D. The Florida State University, 1960

The purpose of the dissertation is to explain the nature of the pessimism which is so deeply ingrained in Jacobean tragedy. The tragedies analyzed are the most important ones of John Webster, Cyril Tourneur, Thomas Middleton, and John Ford. As preparation for study of the plays themselves, the first section of the dissertation is devoted to a discussion of various general causes for intellectual pessimism in the early seventeenth century: the advent of the New Science with its challenge of traditional beliefs concerning the permanence of the physical universe and the extent of God's Providence, schism within the fold of English Protestantism, and James' inept religious policies. However, more especially emphasized as a cause for the transformation of pessimism into a Jacobean state of mind is the deepening of the Puritan mood in England, a mood which attained its intrinsic strength from the Calvinistic conviction of man's spiritual decline as a result of the Fall. It was this idea, widely disseminated by popular Puritan preachers and by the vast amount of sermon literature, which most distinctively influenced theme and structure in the major tragedies of the period. Chapter II surveys these plays and discusses pessimistic attitudes in them which ultimately evolve from the disenchanted view of man as a depraved creature.

The remaining, and larger, portion of the study examines two significant dramatic themes having their origin in the "depravity of man" motif. The first of these is the surrender of man either to his innate tendency toward sin or to the evil of his moral environment. This theme, wherein the hero is unable to regenerate himself from the depths of his own sinful being, appears to some extent in Webster's The White Devil, but more strongly in Middleton's Women Beware Women and The Changeling, and in Tourneur's The Revenger's Tragedy.

The dissertation is concluded with an extensive analysis of Ford's 'Tis Pity She's a Whore, Tourneur's The Atheist's Tragedy, and Webster's Duchess of Malfi from the point of view that each play has its philosophical conflict grounded in the concept of "natural theology" which arose in the Renaissance as a direct result of the idea of man's depravity. Calvinistic-Puritan theology denied the power of human reason to function in religious and ethical matters. Natural theology in the Renaissance was essentially a Christian humanistic position, a reaction against the deprecation of reason—the "light of nature"—in man. In Ford's 'Tis Pity and Tourneur's The Atheist's Tragedy this elevated natural theology, which declared man's capacity to use Reason as well as Revelation in perceiving

the moral law and in determining his own moral destiny, is distorted and debased into a kind of naturalistic atheism. In each play the villain-hero becomes atheistical by carrying the humanistic principle to excess in his arrogant assertion of the primacy of Reason (or "Nature") over divinely revealed sources of moral truth. The conflict between this atheism and conventional morality, between "nature" and Providence furnishes the basis for both tragedies.

Webster's Duchess is the only significant figure in Jacobean tragedy whose outlook reflects that characteristic Christian humanistic fusion of a confidence in God's Providence with a faith in human reason as an illuminator of ethical conduct. Although the Duchess recognizes her innate spiritual capacities, her achievement is obscured by the overwhelmingly pessimistic view of humanity in the play. Viewed in the widest context, Webster's drama is perhaps the best single illustration in Jacobean literature that the optimistic spirit of Renaissance humanism was adamantly blotted out in the early decades of the seventeenth century by an encroaching pessimism.

Microfilm \$3.20; Xerox \$11.25. 247 pages.

DESCARTES' PHILOSOPHICAL, PSYCHOLOGICAL AND MORAL VIEWS ON "THE PASSIONS OF THE SOUL".

(L. C. Card No. Mic 60-1238)

Arthur Hubert Schrynemakers, Ph.D. University of Notre Dame, 1960

This dissertation undertakes a new appraisal of Descartes' The Passions of the Soul. Preparatory to that task, the history of the work is traced, and it is shown that no comprehensive study of it was ever made. In the present study, this treatise is placed in the context of the totality of Descartes' teachings and it is compared with other basic works on emotions.

Descartes' viewpoints on human nature are dealt with at length, and the questions as to whether Descartes actually proposed an extreme dualistic concept of man, and to what extent he can be considered a rationalist, are approached by way of Descartes' motives for adopting his viewpoints. Thus it is shown that Descartes intended to attribute only as much meaning to his statements about the distinction between soul and body and about the "human machine" as he considered necessary for the solution of such problems as the immortality of the human soul and the similarity between human behavior and animal behavior.

He refused, however, to accept deductions from his a priori principles and from his statements, when these deductions conflicted with his experience and observation. Thus, Descartes the rationalist was balanced by Descartes the realist. Therefore, he denied categorically that man is an accidental being, and he kept insisting upon a substantial union of soul and body, since he was convinced of such union through the experience of his emotions.

This same attitude was also confirmed by the comparison of his definition of the "passions" with his description of the emotional process. The former was the result of his literal analysis of the word "passion", while the latter was based on his common sense and his sincerity in his search for truth.

Acomparison of Descartes' views with the James-Lange

theory of emotions shows that Descartes neither anticipated James' or Lange's concepts of the nature of emotions, nor agreed with their theories regarding the primary physical symptoms of the emotional process. He anticipated them only in attributing to the bodily changes the role of maintaining and strengthening the emotions.

A detailed comparison between the opinions of Descartes and Saint Thomas Aquinas reveals that the basic reason for Descartes' deviation from the traditional division of the "passions" consisted in his rule of identifying the simple with the primary and the complex with the secondary, and his practice of considering the prior as the genus of the posterior, while Saint Thomas distinguished between species, primacy, principality and priority.

An analysis of Descartes' description of the primary and the secondary emotions of love, hatred, desire, joy and sadness suggests strongly that Descartes was not as original as he claimed to be, but that he adopted some ideas from Saint Thomas.

Descartes' acceptance of final causality follows from the double function which he attributed to the passions, namely, to excite in the soul the desire for acquiring the things which are beneficial and for avoiding those which are harmful, and to prepare the body for the execution of the appropriate movements.

Since he considered the pineal gland as the instrument of the soul for acting upon the body, and as the place where the body influences the soul, he saw this gland as the battlefield between our emotions and our free will.

The ethical concepts of Descartes were based on the virtue of "generosity", which he regarded as the virtue par excellence, and on the submission to Divine Providence. Thereby one acquires the highest form of wisdom and attains perfect natural happiness.

Microfilm \$4.35; Xerox \$15.30. 338 pages.

PHYSICS

PHYSICS, GENERAL

AN EVALUATION OF THE WASHINGTON UNIVERSITY INTRODUCTORY PHYSICS COURSE AS IT PERTAINS TO THE PROFESSIONAL TRAINING OF MEDICAL STUDENTS

(L. C. Card No. Mic 60-1396)

Fred Donald Boercker, Ph.D. Washington University, 1960

Chairman: Louis M. Smith

The object of this study was to devise and test a method for evaluating a prerequisite course in terms of its effectiveness in a professional sequence. The study concerned specifically the elementary college physics course as a part of the premedical and medical curriculum. The evaluation was based on the extent to which the physics course stressed those topics which the premedical and medical students would encounter in subsequent science courses. The study was restricted to Washington University and Washington University School of Medicine.

All science textbooks used by the premedical students at Washington University and by the medical students during their first two years at Washington University Medical School were examined, using the techniques of content analysis. Each textbook was examined carefully. If a physics concept formed the major thought of a paragraph, it was classified as belonging in one of 40 physics categories and a tabulation was made. In this manner, it was possible to tell which physics concepts appeared and also the frequency with which each appeared.

It was found that two textbooks, those for elementary chemistry and physiology, contained two-thirds of all the physics encountered in the study of medicine. The rest of the textbooks contained only very scattered physics references.

Furthermore, over two-thirds of the physics concepts encountered could be classified in only ten of the 40 categories. That is, a relatively few physics principles accounted for almost all the physics utilized in the study of medicine. These ten important topics are: the Kinetic Theory of Matter, Electrochemical Effects, Atomics and Nucleonics, Electrostatics, Fluids at Rest, X-rays, Work and Energy, Nuclear Disintegration, Change of Phase, and Natural Radioactivity.

In order to determine whether these topics received adequate stress in the physics course, the physics lectures, textbook, problem sets, and examination problems were subjected to content analysis. The results revealed that most of the ten important physics topics received above average emphasis in the physics course. However, there were two exceptions. Natural Radioactivity and Nuclear Disintegration received little emphasis in the course. It was also shown that the physics concepts as they appeared in the science textbooks were at no higher level of difficulty than presented in the physics course. Since most of the important physics topics receive adequate emphasis at an appropriate level, it is suggested that a second year of physics is not necessary for premedical students in the present curriculum.

A criticism of the physics course as a preparation for medicine is that it does not point out biological illustrations of physical principles. Less than three percent of the lecture illustrations showed physics as an explanation for some life process. The textbook, problem sets and examinations were likewise lacking in biological illustrations. Also, many of the biology courses were remiss in utilizing the physics the students have had.

With the exceptions noted --ie., need for greater emphasis in two subject areas and need for pointing out biological illustrations-- the Washington University physics course seemed to provide an adequate subject matter background to the prospective student of medicine.

The methods of content analysis, which to the author's

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knowledge have never been applied rigorously to physical science materials, proved highly satisfactory in this study. Reliability tests yielded percentages of agreement of 0.80 or above. The resulting data proved relevant in the sense that those physics concepts which appeared in the textbooks or lectures most frequently were those which the professors independently rated as most important.

Since the methods used in this study proved valid and relatively simple, they could probably be used to evaluate almost any prerequisite course in a professional sequence, and so provide objective data useful to intelligent curriculum planning. Microfilm \$2.50; Xerox \$6.80. 143 pages.

THE BEHAVIOR OF SEVERAL PHOSPHORS UPON IRRADIATION IN THE VACUUM ULTRAVIOLET

(L. C. Card No. Mic 58-1203)

Richard Louis Conklin, Ph.D. University of Colorado, 1957

Supervisor: Professor William A. Rense

Crystal phosphors have been subjected to intensive research, but for practical reasons the luminescence studied has almost always been that excited by the strong lines of the mercury spectrum or by cathode rays. Such work has indicated that possibly fundamental differences exist between photoluminescence and cathodoluminescence. To understand such differences, data are needed in the transition energy range, between 10 and 100 ev. The purpose of the present work is to examine the behavior of a representative group of phosphors under excitation in this range, using the techniques of vacuum spectroscopy.

The sources of exciting energy were a mercury arc, a hydrogen arc, and a high-voltage spark in air. A concave diffraction grating served as a monochromator to select the desired exciting wavelengths. Luminescence output was measured by an electron photomultiplier tube. The spectral distribution of the emitted light and the efficiency of the phosphor relative to sodium salicylate have been measured for wavelengths between 1500 and 500 Angstroms, and for some wavelengths around 3000 A.

One of the few generally accepted facts of phosphor behavior is that for phosphors with simple emission spectra the spectral distribution of the emitted light is independent of the nature of the exciting wavelength. This has been confirmed in the present work.

Three phosphors activated with divalent manganese (Zn₂SiO₄:Mn, CaSiO₃:Pb:Mn, Zn₃(PO₄)₂:Mn) showed increasing efficiency as the exciting energy increased. Since the increase begins at an energy twice the ionization energy of the Mn²⁺ ion, it may be due to secondary, tertiary, etc., electrons excited within the crystal by the primary photoelectrons.

Three tungstate and titanate phosphors studied (CaWO₄, CaWO₄:Pb, CaMgSiO₃:Ti) all showed decreasing efficiencies as excitation wavelength decreased to 1100 A, followed by a steady increase for shorter wavelengths. We propose that 11.3 ev (1100 A) is the ionization potential of the WO₄²⁻ group, and that the increase of luminescence is due to photoelectrons in the crystal.

Zinc-activated zinc oxide was found to be efficient at

the low-energy end of our exciting spectrum, and for shorter exciting wavelengths its efficiency increased to several times that of any of the other phosphors. This increase may again be attributed to multiplication of electrons within the crystal.

Anomalous results are reported for four phosphors. Mg₆ As₂ O₁₁: Mn, in which the manganese is in the tetravalent form, did not respond to the short wavelengths. BaSiO₃: Pb showed a constant response down to 1000 A, and a sharp decrease to a constant lower response at the shorter wavelengths. There was a most unexpected structure in the response of ZnS: Ag below 1000 A, but ZnCdS: Ag did not respond at all. No explanation has been found for these effects. Microfilm \$2.50; Xerox \$7.80. 166 pages.

EFFECTS OF POLISHING IMPERFECTIONS ON SPECULAR X-RAY REFLECTION FROM VITREOUS SURFACES

(L. C. Card No. Mic 60-1355)

Stuart Bruce Elliott, Ph.D. Stanford University, 1960

The phenomenon of scattered x-radiation in the neighborhood of a focus produced by a curved specular reflector has been investigated both theoretically and experimentally.

A wave-optical treatment is made of the low-angle imaging of a point source by a perfectly smooth spherical mirror. The theoretical scattering from a model "rough" surface completely and randomly covered with cusp-like peaks on the order of 50 A high and 20 μ wide is calculated. The variation of size and shape of peaks is considered.

Measurements of the relative intensity of scattered radiation were made using a point-projection x-ray microscope with Cu target as a point source. Mirrors were mounted on an adjustable support, and images for a wide range of exposures were recorded on film, from which densitometer tracings were made. Points from the linear density portions of each of these tracings combined to give reproducible intensity distribution curves down to relative intensities of about 5×10^{-4} .

Results of this type of experiment indicate that the proposed model of rough surface can account for the low-intensity scattering at angles of more than 10^{-3} radian and that the lower-angle broadening of the reflected beam can be explained by some longer range perturbation of the general mirror contour. It is seen that the almost unavoidable, fine dust particles can be responsible for an appreciable amount of scattering, and that a thin film of organic foreign matter is a very good scatterer.

Studies of mirror surfaces by point projection are described, and there is also a discussion of the polishing of aspherical surfaces, using multiple-beam interferometry to test the evolving contour.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

AN INVESTIGATION OF THE EFFECT OF HIGH TEMPERATURE ON THE SCHUMANN-RUNGE ULTRAVIOLET ABSORPTION CONTINUUM OF OXYGEN

(L. C. Card No. Mic 59-6280)

John Stanton Evans, Ph.D. The University of Tennessee, 1959

Major Professor: Edward G. Harris

A theoretical and experimental investigation has been carried out to determine the absorption coefficient of molecular oxygen at high temperature. The wavelength range covered was in the vacuum ultraviolet region of the spectrum from 1300A to 1750A. The theoretical investigation covered all temperatures from 300° to 10,000° K. The experimental investigation was carried out in the range 4,000° to 10,000° K. All values of the absorption coefficient found apply only to oxygen for which the vibrational degree of freedom is fully excited.

Three types of theoretical calculations were carried out: (1) "reflection" of the ground state wave functions by the potential curve for the excited state, (2) calculation on an IBM 704 computer of vibrational overlap integrals using Morse eigenfunctions for the ground state wave functions and computed solutions of the Schroedinger equation for the excited state wave functions, and (3) use of the Sulzer-Wieland formula, which is a simplified formula for the absorption coefficient and is applicable (at least in principle) to all diatomic molecules a all temperatures.

The experimental investigation was carried out using a one-inch diameter shock tube to produce high temperature samples of oxygen, air and a 10 per cent mixture of oxygen in argon. The absorption in a one by three millimeter beam of ultraviolet light was recorded as a function of time during the passage of shock waves.

Measurements made in pure oxygen agreed best with the absorption coefficients calculated using the IBM 704 computer. An empirical correction for the variation of electronic transition probability with internuclear distance improved the agreement still more except for wavelengths shorter than 1375A. A possible reason for the failure of the correction below 1375A is discussed.

Measurements made in oxygen-argon mixtures confirmed the temperature dependence of the absorption coefficient found using pure oxygen, but at most wavelengths the magnitude was larger. The observed discrepancies ranged as high as 200 per cent and had a relatively weak temperature dependence. Evidence is presented which points to absorption by high temperature argon as the cause of the observed extra absorption.

No absorption coefficients were obtained from the runs made in air because the adjustment of nitrogen vibration interfered with the accurate determination of the jump in light intensity across the shock front. The air data are reported and discussed, however, because of the light they throw on the measurements in oxygen and in oxygen-argon mixtures. Microfilm \$2.50; Xerox \$8.60. 189 pages.

A STUDY OF THE ELECTROMAGNETIC PROPERTIES OF NUCLEONS USING DISPERSION TECHNIQUES

(L. C. Card No. Mic 59-5172)

Paul Gerard Federbush, Ph.D. Princeton University, 1959

The nucleon-photon vertex is studied with the aid of dispersion techniques. The simplest intermediate states appearing in the spectral representation of this vertex are analyzed. It is shown that the two-meson intermediate state probably contributes the bulk of the isotopic vector magnetic moment, but the situation is not so clear as has been sometimes believed. The source of discouragement is the fact that the largest contributions come from nonphysical regions of integration where information not obtainable from experiment is required. An extension into these regions by the usual continuation with Legendre polynomials appears impracticable, if actually valid. The requirement of a unitarity condition shows that the nucleon-pair state gives a small contribution, solving one of the problems of perturbation theory. The effects of strange particles are apparently negligible. The source of the isotopic scalar charge radius remains a puzzle and presumably must be sought in states of greater complexity, containing more than two particles.

Other similar vertex interactions are also studied by the same methods. With certain assumptions a ladder-like approximation is found for each of these vertices.

Microfilm \$2.50; Xerox \$4.80. 91 pages.

BOUNDARY VALUE PROBLEMS IN KINETIC THEORY OF GASES

(L. C. Card No. Mic 58-2303)

Edwin Atlee Jackson, Ph.D. Syracuse University, 1958

An investigation is made of gas dynamics with a special emphasis on the exact treatment of the boundary conditions. There are two situations when it is important to take into account the detailed boundary conditions. The first case which is considered is when the density of the gas is sufficiently low for the mean free path to be of the order of the physical dimensions of the problem. This limit was investigated originally by Knudsen, and is referred to as a Knudsen Gas. In this limit the distribution of velocities in the interior of the gas is largely determined by the distribution function at the boundaries. Therefore, the only statistics involved are the statistics of the boundary conditions. The boundary condition usually assumed is that the molecules impinging on the boundary are partially specularly reflected, the remainder being absorbed and re-emitted with a Maxwellian distribution characteristic of the boundary. Under these assumptions it is clear that the distribution function is a discontinuous function of the velocity at the boundary, and remains discontinuous in the interior. In this investigation we take explicitly into account this feature of the distribution function. The first problem which is treated in this manner is two infinite parallel plates moving with

respect to each other along their planes. A study is made of the results of standard methods for this problem and compared with the present method. It is found that a method devised by Maxwell gives very good results for certain properties of the gas at low densities, but is not adequate in other respects.

The second case when it is important to use the exact boundary conditions is when the boundary conditions change appreciably in a short time. Specifically any change in a time short compared to the time between collisions requires a distinction between two groups of molecules. This is due to the fact that the molecules leaving the boundary are immediately affected by a change in the boundary conditions, while those impinging on it are affected only after a number of collisions. The distribution function for these two groups is therefore initially quite different. This discontinuity tends to be removed after many collisions so long as the boundary conditions are not continually changing. The Rayleigh problem, where an infinite plate is set impulsively into uniform motion in its plane, is of this type. This problem is treated using discontinuous distribution functions, and is compared with the usual treatment. It is found that the standard treatment is inaccurate for times less than a few collision periods.

The process of Knudsen iteration, in which the distribution function is obtained as a power series in L/λ (physical dimensions over the mean free path), is investigated. It was noted that if a finite number of terms in this series are kept, then most of the moments of the distribution function are divergent. These divergences have been ascribed to the geometry of the boundary. In our investigation we indicate the reason for these divergences, noting that they are not due to any geometric effects.

Microfilm \$2.50; Xerox \$3.80. 69 pages.

1. Knudsen, M., The Kinetic Theory of Gases, Methuen & Co. Ltd., London, 1934.

ON THE QUANTUM THEORY OF GENERAL RELATIVITY

(L. C. Card No. Mic 59-5218)

Gerald Rosen, Ph.D. Princeton University, 1959

The basic mathematical concepts in a Feynman field quantization are reviewed. We discuss canonical transformations and classical correspondence. Special attention is given to the interpretation of Feynman operators in the canonical formalism. We derive the generalized commutator theorem.

The pertinent work of Misner and Wheeler is surveyed. We emphasize Misner's method of extracting information from the formalism.

The scale-gauge is introduced into the theory. This quantity relates each Feynman geometrical history to a unique, conformally equivalent, auxiliary history. Most of the significant operators in the theory are evaluated by merely studying the invariance properties of the scale-gauge functional integrations. The results for some typical operators appear in table form. Consideration is given to

expectation values. We mention the formal extensions which are necessary in order to convert the expectation values of a gauge-invariant theory into experimental predictions.

By appealing to invariance arguments once again, we derive the basic canonical commutation relations of the theory. These equations are remarkable in that they involve components of the metric tensor operator in a homogeneously linear fashion. We discuss the nature of ordering ambiguities in the more complicated operators. The commutation relations associated with the scale-gauge operator are presented. In the traditional sense, the scale-gauge is quantum mechanically conjugate to the trace of the second fundamental form of the hypersurfaces of constant time. Microfilm \$2.50; Xerox \$3.00. 58 pages.

FERRIMAGNETIC RESONANCE IN POLYCRYSTALLINE YTTRIUM IRON GARNET

(L. C. Card No. Mic 60-1374)

Philip Edward Seiden, Ph.D. Stanford University, 1960

This investigation was designed to obtain a more complete description of the resonance parameters of the yttrium iron garnet system at both small signal and high power levels. To do this, a number of sets of polycrystalline samples were made whose composition varied in a systematic way. The composition was varied by choosing the desired ratio of Y_2O_3 to Fe_2O_3 used in the manufacture of the samples. The finished samples ranged from 25 per cent iron excess through stochiometric proportions to 15 per cent yttrium excess. In preparing the samples, four different firing atmospheres were used (air, oxygen, nitrogen, and argon) to obtain different states of sample oxidation. A number of sets were fired in each atmosphere to evaluate reproducibility.

Ferrimagnetic resonance experiments were performed at 9317 Mc, and the linewidth, g-value and saturation curves of microwave susceptibility as a function of rf magnetic field strength were obtained. In addition, saturation magnetization and x-ray diffraction measurements were made and photomicrographs of the samples were taken.

The x-ray diffraction data and photomicrographs show that no substitution occurred in the garnet lattice and all excess material went into ceramic second phases. These phases show up clearly in the photomicrographs as regions of approximately the size of a few crystallites. The phases observed were YFeO₃ for yttrium excess, Fe₂O₃ for iron excess samples fired in oxidizing atmospheres, and Fe₃O₄ for samples fired in neutral atmospheres.

Theoretical values for the saturation magnetization, g-value and linewidth of the samples were calculated based on the assumption that all excess material goes into ceramic second phases distributed through the sample as non-magnetic inclusions (equivalent to pores). The agreement between theory and experiment is quite good for saturation magnetization and g-value. For linewidth the strong dipolar coupling must be accounted for. This was done using a theory of Geschwind and Clogston. The domain of applicability of this theory is discussed in

connection with the experimental results. Corrections were applied for a second phase of Fe₃O₄ which are necessary since this phase is itself magnetic.

The saturation curves of susceptibility vs. rf magnetic field were investigated in order to determine the initial decline in susceptibility. The decline is initially a quadratic function of the rf magnetic field. A recent theory of Schlömann that considers the effect of inhomogeneities in the sample predicts a behavior of this type. We have derived an expression from a phenomonological equation of Callen that also predicts this dependence. The resulting expression is

$$\frac{x''}{x_O''} = \frac{1}{1 + \frac{\pi \gamma}{H_O \lambda_{k\sigma}} h^2}$$

h being the rf magnetic field, H_O the dc field, γ the gyromagnetic ratio, and $\lambda_{k\sigma}$ a parameter defined by Callen which is proportional to the transition probability for spinwaves going into lattice phonons.

Consideration is given to the method of measuring the spinwave linewidth from the instability threshold. It is found that the whole saturation curve is needed if the instability effects are to be separated from the effects which cause the initial decline in susceptibility.

While carrying out measurements at high rf signal levels, discontinuities were observed in the power reflected from the cavity containing the sample as the incident power was raised. When the complete resonance curve was observed, it was found to become asymmetric at high power levels, and discontinuities appeared at various places on the curve. The origin of these discontinuities is not understood.

Microfilm \$2.50; Xerox \$4.40. 85 pages.

PHYSICS, NUCLEAR

INELASTIC SCATTERING OF 14 MEV NEUTRONS FROM Si²⁸, Mn⁵⁵, AND Co⁵⁹.

(L. C. Card No. Mic 60-1386)

George Burton Bunyard, Ph.D. Vanderbilt University, 1960

Supervisor: Professor Cyril D. Curtis

The associated-particle time-of-flight technique has been used to observe the energy distributions at 90° of 14 Mev neutrons inelastically scattered from Si²⁸, Mn⁵⁵, and Co⁵⁹. The time-of-flight spectrometer employed the vernier chronotron principle for measuring time intervals. Various preliminary tests of the instrumentation are described.

After corrections for background, detector efficiency, and energy interval per time channel, the data are compared with the predictions of the statistical theory of nuclear reactions. This theory incorporates the Bohr hypothesis of the compound nucleus; it makes the additional assumption that the probability of emission of a specified particle from the compound nucleus may be

calculated on a statistical basis (i.e., different modes of particle emission are treated on an equal footing). The energy distribution predicted by statistical theory is

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$$I(E_n)dE_n = K E_n\sigma_C(E_n) w(E_0-E_n) dE_n$$

for neutrons scattered with energies E_n to $E_n + dE_n$ in the inelastic scattering reaction $X(n,n')X^*$. The level density of the residual nucleus X^* at an excitation energy $E^* = (E_o - E_n)$ is given by $w(E_o - E_n)$ for incident neutron energy E_o . The cross section for formation of the compound nucleus by the inverse of the $X(n,n')X^*$ reaction is given by $\sigma_C(E_n)$. The level density is assumed to have the form $w(E^*) = K e^2 \sqrt{aE^*}$ or $C e^{-E_n/T}$ for $E_n \ll E_o$, where

T is a constant called the "nuclear temperature" of the residual nucleus after emission of the neutron. Using this last form for the level density, the predicted neutron energy distribution is Maxwellian with its maximum intensity at E = T, since $\sigma_C(E_n)$ is essentially constant.

Plots of $\log(I/E_n\sigma)$ vs. E_n give the relative level density for the three isotopes and are found to be reasonably linear in the energy region from 0.8 to 4 Mev for Mn⁵⁵ and Co⁵⁹. The slopes of these linear portions imply nuclear temperatures of 1.08 \pm 0.1 and 0.97 \pm 0.1 Mev for Mn⁵⁵ and Co⁵⁹ respectively. The Si²⁸ level density curve exhibits two distinct linear portions with slopes corresponding to nuclear temperatures of 0.5 and 2 Mev for the low- and high-energy emitted-neutron regions respectively.

Since the binding energies of a neutron in Si²⁸, Mn⁵⁵, and Co⁵⁹ are 17.4, 10.3, and 10.5 Mev respectively, an (n,2n) reaction for Mn and Co is highly probable. A calculation of the energy distribution for an (n,2n) reaction for Co⁵⁹ has been compared with the experimental data; the fit of the calculation to experimental data is only fair. The resolution of this experiment is not considered adequate to differentiate the first and second neutron contributions to the spectra. These calculations indicate that second neutron emission would lower the observed nuclear temperature by at least 0.1 Mev.

Three possible processes which may explain the observed structure in the Mn⁵⁵ spectrum are proposed. Simultaneous emission of two neutrons is a possible process for explaining one maximum in the spectrum. A second process involving successive emission of two neutrons assumes a well separated group of levels at 1.2 Mev in the residual Mn⁵⁴ nucleus to explain three of the observed spectral maxima. An oscillation of level densities in both Mn⁵⁵ and Mn⁵⁴ is a third possible explanation of the observed structure.

All spectra exhibited a larger contribution from emitted neutrons of energy greater than 4 Mev than is predicted by statistical theory. This excess of high energy neutrons is discussed in terms of direct interaction effects and of selection rules favoring transitions between widely separated levels for compound nucleus processes.

The observed data fit the predictions of the statistical theory reasonably well for emitted neutrons of energy less than 4 Mev, but the concept of statistical sharing of energy by all nucleons in the compound system is not supported.

Microfilm \$2.50; Xerox \$5.40. 108 pages.

VELOCITY DEPENDENCE IN THE TWO-NUCLEON INTERACTION

(L. C. Card No. Mic 60-818)

Robert Leonard Carovillano, Ph.D. Indiana University, 1959

In the present work, an investigation of the velocity dependence in the two-nucleon interaction is initiated. The second order potential, which is the exact asymptotic potential, is derived in detail using the Tamm-Dancoff procedure in the ps - ps meson theory. Some attention is also given to the second order potential in the scalar meson theory, although this case is not of primary physical interest. Previous efforts in deriving meson theoretic potentials are not in general agreement with each other. The basic differences arise from the desire to restrict attention to static potentials. Phenomenological work with potentials, however, has pointed out the importance of a velocity dependence, so it is time enough to drop past procedures designed to remove all non-locality from meson theoretic potentials.

The physical implications of having energy and velocity dependent potentials is discussed at length. The second order two-nucleon interaction is rigorously shown to be hermitian at all energies. A consistent reduction to non-relativistic energies will therefore result in an hermitian potential. (One thinks of the energy as the expansion parameter.) The energy dependence indicates the eigenfunctions are not orthogonal, but the essential property of completeness remains. Because the potential is non-local, the stationary state continuity equation is altered from the usual point relation and is satisfied in a small volume about the position of the particles.

The velocity dependent corrections to the static second order potential are evaluated in the Born approximation and by a more elaborate "effective potential" technique. The Born approximation result demonstrates the necessity of retaining the energy dependence in the potential in order to get the same scattering amplitude as one obtains from the one pion contribution in S-matrix theory. The Born approximation result also shows that velocity corrections of order p² are likely to be important at 300 Mev., while contributions of order p4 and higher are not likely to be important. The "effective potential" calculation indicates the velocity corrections are likely to be especially important in triplet states, increasing in size with increasing energy. Quantitative estimates of the velocity corrections require an exact treatment of the Schroedinger equation. In an exact consideration, it is shown there is no spin orbit component in the second order meson theoretic potential.

The possibility of substituting the unphysical hard core hypothesis by a velocity dependence is discussed, and an example is worked out supporting the idea. It is shown that the ¹S phase shift, which best exhibits the hard core, can be accurately predicted by a velocity dependent square well with reasonable parameters.

The Schroedinger equation, revised by the velocity dependent potential, is shown to have regular solutions at the origin, in certain cases, even though the potential is highly singular. Since meson theoretic potentials are highly singular at the origin, this is a very encouraging result admitting the possibility that meson theoretic potentials may have applicability even down to small distances.

Finally, an extensive program of further research, which would allow direct experimental verification of the non-local features of the potential, is outlined.

Microfilm \$2.50; Xerox \$5.00. 98 pages.

RESONANCE ABSORPTION IN NUCLEAR REACTORS

(L. C. Card No. Mic 59-5169)

Lawrence Dresner, Ph.D. Princeton University, 1959

The problem of resonance absorption of neutrons in nuclear reactors is considered. Formulae for the effective resonance integral of single resonances are given in the "narrow resonance" approximation in homogeneous media, and in the "narrow resonance" and "infinite mass absorber" approximation in heterogeneous media. It is shown that the Doppler effect in homogeneous media can be expressed through a certain function of two variables, $J(\xi,\beta)$. The properties of this function are studied in detail, and a tabulation given. The effect of interference between resonance and potential scattering on the effective resonance integral is studied. In heterogeneous media in the "narrow resonance" case it is shown that the Doppler effect can again be expressed through the same function, $J(\xi,\beta)$, as in the homogeneous case if a rational approximation for the average escape probabilities due to Wigner is introduced. Furthermore, it is shown that then a formal identity exists between the homogeneous and heterogeneous cases for "narrow" resonances. The error caused by Wigner's rational approximation is studied in detail, and in the case of no Doppler broadening and no interference scattering an improved formula is suggested. In heterogeneous media in the "infinite mass absorber" case an approximate expression for the albedo of an absorber lump is suggested on the basis of heuristic arguments. Precise calculations of the albedo based on a variational method of solving the monoenergetic transport equation are compared with this approximation, and show it to be quite accurate. Use of the approximate albedo again permits expression of the Doppler effect through the function $J(\xi,\beta)$. The effect of interference between potential and resonance scattering is also studied in the "infinite mass absorber" approximation. These results are applicable to calculating the absorption in low energy resolved resonances for which the widths and energy are known. In the region beyond the experimental limit of resolution statistical considerations are employed. The formulae for single resonances are averaged over the probability distributions of the partial widths. The theory is then applied to the calculation of the effective resonance integrals of uranium and thorium rods, and good agreement is obtained for uranium and fair agreement for thorium.

At high energies resonance absorption cross sections fall sufficiently low to permit neglect of flux depression effects, and attention is focussed on average reaction cross sections. A study of the effect of fluctuations in the partial widths on average reaction cross sections is given. Some general theorems are derived independent of the probability distributions of the widths. If the widths

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are distributed in member distributions of the chi-squared family, it is shown that the multiple integrals over these distributions which express the averages $<\Gamma_s\,\Gamma_t/\Gamma>$ can be reduced to a single infinite integral. This integral is evaluated in the eighteen simplest cases of interest. A Monte Carlo program for the electronic computer ORACLE for evaluating these averages is described. It is shown that enough experimental data on neutron reactions in U²³⁸ exists below 500 kev to overdetermine the s-, p-, d-, and f-wave strength functions. Analysis of the data including the important effects of fluctuations in the widths yields consistent values for the strength functions, in support of the theory. Finally, the statistical formalism of Hauser and Feshbach is transformed from the channel spin representation to another which is more convenient in the presence of spin-orbit coupling. The effect of small amounts of spin-orbit coupling in the analysis of the U²³⁸ reaction data is found to be unimportant. Finally, it is proven that the total, the compound nucleus formation, and under certain circumstances, the radiative capture cross sections are independent in first order of spin-orbit coupling in the neutron-nucleus interaction.

Microfilm \$3.40; Xerox \$11.95. 263 pages.

THE MULTIPLY CHARGED COMPONENT OF THE PRIMARY COSMIC RADIATION AT A LOW ENERGY CUT-OFF DURING SOLAR MAXIMUM

(L. C. Card No. Mic 60-1397)

Carl Edwin Fichtel, Ph.D. Washington University, 1960

Chairman: Professor M. W. Friedlander

Ever since particles of charge greater than two were discovered in the primary cosmic radiation about ten years ago, attempts have been made to learn more about these particles and to compare their properties with those of the doubly charged alpha particles. This particular experiment was aimed at studying the multiply charged component of the cosmic rays at a time of solar maximum, so that its characteristics could be compared to those at solar minimum. The experiment was performed at a high geomagnetic latitude (55°N), where the energy cut-off imposed by the magnetic field of the earth would be small.

A large stack of nuclear emulsions was carried on a high altitude balloon flight on July 30, 1957 from Minneapolis, Minnesota. The balloon was at approximately 106 thousand feet for a period of 8 hours and 51 minutes. The stack was rotated into the vertical position shortly after the balloon reached ceiling to avoid the difficulties of a large correction to the flux for particles entering during the ascent. The emulsions were processed using the hot plate method, and very even development was achieved throughout the emulsions.

A line scan was performed near the top of the processed plates under a microscope. Stringent scanning criteria were adopted, and the scanning efficiency was checked in several different ways, with the net result of nearly 100% efficiency. Protons were eliminated by a simple measurement of their grain density and their mean angle of deflection. The energy of each multiply charged

particle was estimated by measuring the mean angle of deflection. In the case of alpha particles, the grain density was used as a second measure of the energy in the low energy region. The charge of the particles was determined by both the delta ray and the grain density methods, wherever possible.

It was found that the alpha particle flux and the flux of particles with a charge greater than two were both reduced by a factor of two as compared to their values at solar minimum. The energy spectrum obtained from this experiment combined with data from other experimentalists at lower latitudes showed that the entire energy spectrum that could be measured was the same for alpha particles, particles of charge six through nine, and particles of charge greater than ten. The charge spectrum in general was found to be the same as observed during solar minimum. A closer look at the charge spectrum showed that good resolution between charges had been obtained. The following features were observed: a lithium flux that was of the same order as the berylium or boron one, a large excess of even charges above charge nine, a greater abundance of carbon than oxygen, as observed during solar minimum, and an extrapolated flux of lithium, berylium, and boron at the top of the atmosphere which amounted to about 20% of the total flux of particles with a charge greater than two.

No theory has yet been able to explain all the characteristics of the change of the cosmic rays during solar maximum; however, the cause is believed to be electromagnetic, and, therefore, one would expect the energy spectra of all particles with a charge in the range of two to about twenty to change in the same way because they have nearly the same charge to mass ratio. The experimental results are shown to be in fair, but not perfect, agreement with an electric deceleration model.

Microfilm \$2.50; Xerox \$6.80. 144 pages.

A STUDY OF THE CORE PARAMETER IN THE NUCLEAR POTENTIAL BY ITS INFLUENCE ON THE BINDING ENERGY OF THE He⁴ NUCLEUS

(L. C. Card No. Mic 60-368)

Victor Flores-Maldonado, Ph.D. Cornell University, 1959

Theoretical calculations of the binding energy of the three and four nucleon systems with the assumption of reasonable central potentials without core give results that are too high when compared with the experimental values. When tensor potentials of adjustable range are added, the theoretical binding energy is lowered, but the experimental electrostatic energy of He³ and the experimental size of He⁴ still remain unexplained. With a central potential with a hard core the electrostatic energy and the binding energy of the three nucleon systems have recently been explained.

In the present work a hard core is added to a central potential and the binding energy of the He⁴ nucleus is evaluated for several core radii. Two wave functions are considered simultaneously, a Gaussian suitable for a potential without core, and a "hollow Gaussian" suitable

for a potential with core. The parameter of these wave functions is here adjusted so as to reproduce the root mean square radius obtained from electron-He⁴ scattering experiments.

The binding energy is found by calculation of the expectation value of the Hamiltonian which, it is assumed, consists of the three usual terms, the potential energy, the kinetic energy and the electrostatic energy.

A two nucleon potential of the exponential form with hard core adjusted so as to satisfy the low energy neutron proton data is considered. The core radius is taken equal to zero in the case of the Gaussian wave function and different from zero in the case of the hollow Gaussian wave function. In this latter case, some approximations are used in the evaluation of integrals, all of which are discussed in the text.

For the most part, the evaluation of the integrals involved is simplified by evaluating them first, with an auxiliary wave function which contains six arbitrary parameters. Then the results are differentiated with respect to the parameters and finally the parameters are set equal to each other.

Results: In the case of a potential without core, the correct binding energy is found; this seems to indicate that the method of obtaining the wave function from the experimental density distribution is very effective. In the case of a potential with a hard core, it is found that the potential energy is very sensitive to the value of the hard core; this agrees with the results obtained for the three body system. A region is found, around a core radius of 0.5 fermis, in which the experimental binding energy and size of the He⁴ nucleus can be reproduced theoretically.

Microfilm \$2.50; Xerox \$4.00. 72 pages.

ELASTIC SCATTERING AND REACTIONS DUE TO PROTONS ON O¹⁸

(L. C. Card No. Mic 60-1557)

Chong Chol Kim, Ph.D. State University of Iowa, 1960

Chairman: Professor James A. Jacobs

The elastic scattering O^{18} (p,p) O^{18} and the reactions O^{18} (p,p' γ) O^{18} , O^{18} (p, α_0) N^{15} and O^{18} (p, $\alpha_{1,2}\gamma_{1,2}$) N^{15} were studied using a thin gas target with the State University of Iowa 4 Mev Van de Graaff generator. Absolute differential cross-sections were measured for the two laboratory angles 86.8° and 159.5° in the incident proton energy range 790 to 3550 kev and angular distributions for α_0 and p were measured at several energies. Relative yield curves were obtained for O^{18} (p, γ) in the same energy range as above. Five F^{19} levels were observed which have not been previously reported and some new decay modes for previously known levels were observed. From consideration of the detailed shape of the elastic scattering anomalies and the angular distributions spin and parity assignments were made to some F^{19} levels as follows:

Resonance energy	Resonance Mode	Spin, parity	Excitation Energy (Mev)
Eo (kev)			
844 1736	p, γ, α_0 α_0	$\frac{1/2}{3/2}$ -	8.763 9.609
1765 2007	p, γ, α_0 p, α_0	3/2+ 1/2+	9.636 9.865

Microfilm \$2.50; Xerox \$4.60. 90 pages.

SINGLE PARTICLE STATES IN STRONGLY DEFORMED NUCLEI

(L. C. Card No. Mic 60-1411)

Richard H. Lemmer, Ph.D. The Florida State University, 1960

The effects of the non-local character of the average nucleon-nucleus interaction on single particle motion in a strongly deformed field are examined by using a single phenomenological description of the non-local interaction and introducing an effective mass approximation for a finite nuclear system.

A perturbation procedure is outlined whereby the effects of deforming the average single particle nuclear field can be studied once the energy levels and wave functions of the corresponding spherical potential are known.

The qualitative aspects of nuclear motion in a nonlocal deformed potential well are discussed in this manner, using an oscillator potential shape for purposes of orientation.

Finally, detailed numerical calculations of single particle states in a realistic deformed potential well are carried out, and an analysis of ground state spins and magnetic moments of strongly deformed nuclei is presented. The results are examined in relation to recent related calculations based on local potential wells and evaluated in terms of existing experimental data.

Microfilm \$2.50; Xerox \$6.00. 123 pages.

DIRECTIONAL DEPENDENCE OF ATMOSPHERIC TEMPERATURE EFFECTS ON HARD COMPONENT OF COSMIC RADIATION

(L. C. Card No. Mic 60-1534)

Kaichi Maeda, Ph.D. The University of Nebraska, 1960

Adviser: Robert Lee Chasson

To see the zenith angle dependence of atmospheric temperature effects on cosmic ray intensity at sea level, the coefficients of partial temperature effects have been calculated, which indicate the contributions of temperature changes at different levels in the atmosphere to the change of directional intensity of cosmic ray muons at sea level.

The calculation is based upon the rigorous solution of the diffusion equation of cosmic ray mesons in the standard atmosphere. Under the conditions of non-linearity of ionization loss with momentum in the low energy region and the logarithmic increase of radiation loss in the relativistic high energy region, the survival probability of obliquely incident muons in the atmosphere is computed. In this computation the change of zenith angle of the straight path of muons, due to the curvature of earth's surface, is precisely taken into account. Furthermore, the following points are discussed: (i) the geomagnetic deflection of muons in the atmosphere, (ii) the generalized production spectrum of muons, which gives proper zenith angle dependence of muon intensity provided that it is corrected for multiple Coulomb scattering of muons in the atmosphere, and (iii) the contribution of K-mesons to the positive temperature effect.

Among the results, the noteworthy points are as follows: (i) corresponding to the effective height of muon production, there is a level of maximum contribution to the negative and positive temperature effects, the height of which level increases with increase of zenith angle; (ii) the negative temperature coefficient averaged around the level of maximum contribution shows a maximum at the zenith angle of approximately 75°; (iii) the greatest part of the positive temperature effect found from statistical analysis is due to the change of the density distribution of the air, which gives a change of momentum loss of muons in the atmosphere; (iv) the combined coefficients of positive and negative temperature effects is approximately constant with respect to the atmospheric depth. Therefore, the so-called "mean mass temperature" is a good practical approximation for the correction of cosmicray data for the temperature effects; (v) geomagnetic deflection of muons in the atmosphere is not negligible for the negative temperature effect even at middle latitude (geomagnetic latitude 50°) which leads to a larger temperature coefficient for positive muons arriving from the east than for negative muons from the east, and vice versa for those coming from the west direction. Owing to the lower geomagnetic cut-off energy for the west direction, which gives a relatively higher intensity of low-energy muons, the negative temperature effect as a whole is larger for the west direction than for the east; (vi) the contribution of K-mesons is such as to suppress the increase of the positive temperature coefficient with higher energy of observed muons.

To verify the above results, two kinds of experiments are proposed. One is the continuous measurement of muon intensity (intensity of hard component) for oblique directions in the geomagnetic east-west plane, and the other is the measurement of muon intensity underground below 100-1000 meters of water equivalent depth.

Microfilm \$2.50; Xerox \$8.00. 174 pages.

ANGULAR CORRELATION STUDY OF THE $Mg^{24}(d,p\gamma)Mg^{25}$ STRIPPING REACTION AS A TEST OF THE DISTORTED WAVE THEORY.

(L. C. Card No. Mic 60-1340)

Joseph Pourcher Martin, Ph.D. University of Pittsburgh, 1959

Angular correlations between protons from the ${\rm Mg}^{24}({\rm d,p}){\rm Mg}^{25}$ reaction leading to the 3.40 Mev excited state of ${\rm Mg}^{25}$ and the resulting de-excitation gamma rays were investigated to test the validity of the distorted wave stripping theory. A natural magnesium target was bombarded by 15 Mev deuterons and proton-gamma coincidences were counted, using scintillation detectors in conjunction with conventional fast-slow coincidence circuitry. The correlations were studied at laboratory proton scattering angles of 15° and 45° , each in two mutually perpendicular planes: the reaction plane and the plane perpendicular to it containing the deuteron axis. The angular distribution of protons from the same level was also measured and fitted by a Butler stripping curve with $f_n = 1$ and $r_0 = 5.0$ fermis.

The coordinate system used to describe the correlations is defined with the z-axis in the $\vec{k_d}$ x $\vec{k_p}$ direction and the x-axis in the recoil nucleus direction. Correlation functions found by least squares fits to the experimental data are, for the 15° proton angle,

$$W(k_d, k_p, \frac{\pi}{2}, \phi) = 1 - (0.385 \pm 0.023) \cos^2 (\phi - \phi_0)$$

with $\phi_0 = -27.7^0 \pm 2.9^0$ and

 $W(k_d, k_p, \theta, \phi_r) = 1 + (0.145 \pm 0.029) \cos^2 \theta$ where ϕ_r is the beam direction. The functions found for the 45° proton angle are

$$W(\vec{k_d}, \vec{k_p}, \frac{\pi}{2}, \phi) = 1 - (0.366 \pm 0.033) \cos^2(\phi - \phi_0)$$

with $\phi_0 = -6.8^{\circ} \pm 3.5^{\circ}$ and $W(\vec{k_d}, \vec{k_p}, \theta, \phi_r) = 1 + (0.279 \pm 0.038) \cos^2\theta$.

These observed correlations are in good agreement with the predictions of the distorted wave theory. It is to be noted in particular that this excellent agreement at 45° indicates that protons scattered at this angle arise from the stripping process in spite of the fact that the disagreement between Butler stripping theory and the measured angular distribution is greatest here. This then suggests that protons observed in the entire region beyond the first maximum of a typical angular distribution are due to stripping and might be adequately described by stripping theory if suitably distorted waves are used in the analysis. Microfilm \$2.50; Xerox \$3.60. 63 pages.

THE ANALYSIS OF NON-UNIFORM NUCLEAR REACTORS

(L. C. Card No. Mic 60-1299)

David Arthur McCutchan, Ph.D. North Carolina State College, 1960

Supervisor: Raymond Leroy Murray

Efficient methods were sought for the solution of nonuniform reactor problems in one- and two-group, steadystate diffusion theory. Attention is restricted to reactors with continuous spatial variation in composition, for which diffusion theory is adequate. The results are applicable, however, to heterogeneous reactors with macroscopic variation in nuclear properties.

One-group diffusion theory is first discussed. The ordinary differential equations describing diffusion in simple geometries are reformulated as integral equations, and as a variational equation. Numerical, variational, and iterative methods are then compared for two one-group problems whose solutions are tabulated.

An effective analytical method ("wave perturbation") involves the rearrangement of the differential equation and the subsequent derivation of a Volterra integral equation which is solved iteratively. This perturbation method compares favorably with classical methods utilizing orthogonal functions. In one case the error in the second order estimate of an eigenvalue was only 0.007 percent, while the corresponding Rayleigh-Schrodinger approximation was in error by 2.5 percent. It is found that the application of the wave perturbation method can in many cases be systematized by use of Laplace transformation. The transformed equation is iterated and the problem then reduces to the inversion of the result. This is conveniently accomplished by reference to a table of Laplace transform-pairs, a set of which is constructed by a recursive procedure.

Analytic solutions are derived in two-group theory for reactors with flux or power distribution previously specified as a polynomial or Fourier series. The results for the infinite slab, sphere, and infinite cylinder are derived and a comparison is presented of the loadings required for the reflected spherical reactor with flat thermal neutron flux, uniform power and a conventional, uniform core. The wave perturbation method may be used to attack the general problem, and is illustrated in the case of the sphere with linearly varying fuel. The transform table previously developed is used to carry out the perturbation process as before.

Microfilm \$2.50; Xerox \$7.60. 163 pages.

NUCLEAR CHARGE DISTRIBUTION IN FISSION: INDEPENDENT YIELDS OF Ba¹⁴¹, Cs¹⁴¹, La¹⁴¹, La¹⁴², Ce¹⁴³, AND CUMULATIVE YIELD OF Xe¹⁴² FROM THERMAL-NEUTRON FISSION OF U²³⁵.

(L. C. Card No. Mic 60-63)

David Robert Nethaway, Ph.D. Washington University, 1959

Chairman: Arthur C. Wahl

Rapid chemical separations were used for the determination of the following independent fractional chain yields from the thermal-neutron fission of U^{235} : Ba¹⁴¹, 0.27 ± 0.06; La¹⁴¹, 0.004 ± 0.002; La¹⁴², 0.018 ± 0.006; and Ce¹⁴³, 0.010 ± 0.004. The independent yield of Cs¹⁴¹ is 0.52 ± 0.08, the difference between unity and the sum of the measured yields for the other members of the isobaric chain. The nuclide Xe¹⁴² was identified for the first time; its cumulative fractional chain yield was measured to be 0.059 $^{+0.006}_{-0.003}$. The following half-lives were measured: Cs¹⁴¹ 26 ± 3 sec, Cs¹⁴² < 5 sec, Xe¹⁴² ~ 1.5 sec, and Ba¹⁴³ 13 ± 3 sec.

It was found that the charge distribution in the thermal-neutron fission of U^{235} is best described by the most probable charge (Z_p) values predicted by the postulate of equal charge displacement, coupled with a distribution of charge about the most probable value, for all mass numbers, given by

 $P(Z) = \frac{1}{\sqrt{c\pi}} e^{-(Z - Z_p)^2}$,

where C = 1.00.

The yields of more than one member are known for six isobaric chains. Some indication of a variation in the charge distribution function with mass number was found from the individual charge distribution curves which had been fitted to the independent yield data for these chains. The values of \mathbf{Z}_p calculated from these individual isobaric charge distribution curves were found to be in good agreement with the values predicted by the postulate of equal charge displacement and with the empirical \mathbf{Z}_p function based on the proposed distribution curve.

The heterogeneous exchange between Ba⁺⁺(140) and BaSO₄ precipitates was studied. The exchange is complete in ~1 second under most conditions investigated. However, in the presence of uranyl ion, the exchange is incomplete in ~1 second, unless sulfate ion is also present.

Microfilm \$2.50; Xerox \$4.60. 86 pages.

A CLOUD CHAMBER STUDY OF THE UNSTABLE PARTICLES PRODUCED IN NUCLEAR INTERACTIONS OF THE COSMIC RADIATION AT MOUNTAIN ALTITUDE

(L. C. Card No. Mic 60-1401)

Medford Sherman Webster, Ph.D. Washington University, 1960

Chairman: Robert D. Sard

Ten thousand sets of photographs of expansions of a double cloud chamber arrangement have been obtained at

mountain altitude. The expansions were triggered by a conventional penetrating shower selector. Ionizations were measured by drop-counting in the upper chamber and a multiplate chamber containing eleven half inch brass plates was placed immediately beneath the drop-count chamber.

Each set of photographs has been searched by at least one physicist for strange events. Examples of most of the well-established strange particle decays have been found and the analysis of a typical case of each is discussed in detail. The yield of interesting pictures is in general agreement with that found by other laboratories under similar conditions.

Nine of the events are positively identified as \bigwedge^0 -decays with known origins, the the decay angle in the rest frame of the \bigwedge^0 has been calculated for each of these cases. The distribution of angles indicates a somewhat larger transverse component of momentum for the decay products than is expected from an isotropic distribution, but this departure from isotropy is not statistically significant in such a small sample. No evidence for the longitudinal asymmetry which has been reported recently has been found in this small sample.

In addition to the examples of the established decays, two unusual events have been found. One of the positively identified \bigwedge^0 -decays shows an electron associated with the π -meson. The energy of the electron is too large to permit interpretation as a knock-on electron and it is most probably a Compton electron from a low energy nuclear gamma-ray emitted by the nucleus which absorbed the meson.

The other unusual event shows a particle stopping near the surface of a plate and emitting one visible secondary. Measurements of the range, ionization and scattering of the primary indicate that it is quite definitely lighter than a K-meson. The track of the secondary is above minimum ionization and is straight in all views. This precludes interpretation as a π - μ -e sequence. If the event is interpreted as a nuclear absorption of a slow negative π -meson, the ionization of the secondary requires an energy very close to the maximum permitted by conservation of energy and momentum between the emitted proton and the recoil nucleus. The mass measurements on the primary permit a mass assignment somewhat larger than the π -meson mass and the event is consistent with the decay of a particle with a mass intermediate between that of the π - and K-mesons. The primary is, however, produced in a nuclear interaction immediately above the chamber, and the failure of other workers to find such a particle under comparable circumstances argues forcefully in favor of the π -meson interpretation.

C. Card No. Mile Souldelly

Microfilm \$2.50; Xerox \$7.60. 161 pages.

p'-γ ANGULAR CORRELATION IN THE INELASTIC SCATTERING OF 16.6 MEV PROTONS BY Mg²⁴.

(L. C. Card No. Mic 60-1480)

Hajimé Yoshiki, Ph.D. Princeton University, 1959

The angular correlation between the inelastically scattered protons leaving the first excited state of Mg²⁴ (1.37 Mev, 2+) and its deexcitation gamma rays produced by the bombardment of 16.6 Mev protons on a natural magnesium target has been investigated. For $\theta_p^1 = 30^\circ$, 42.5° , and 70° the result shows that the correlation functions are represented fairly well by the simple Born approximation calculation, $\sin^2 2(\theta_{\gamma} - \theta_0)$. However, at larger angles, $\theta_p^1 = 95^\circ$, 120° and 150° , changes in the shapes of correlation curves are observed, introducing a contribution from a $\sin^2(\theta_{\gamma} - \theta_0^1)$ term. This fact suggests the existence of exchange effect as well as the distortion effect in the present nuclear reactions.

Microfilm \$2.50; Xerox \$7.40. 159 pages.

PHYSICS, SOLID STATE

THERMO- AND GALVANOMAGNETIC EFFECTS
IN SINGLE CRYSTALS OF ZINC AND TIN
UNDER THE INFLUENCE OF HIGH PRESSURES
AND LOW TEMPERATURES

(L. C. Card No. Mic 60-1460)

Kanwal Singh Balain, Ph.D. Louisiana State University, 1960

Supervisor: Dr. Claude G. Grenier

This work can be divided into categories, the first one being a study made on oscillatory Ettinghausen-Nernst and Hall effect in a single crystal of zinc under high pressure, the second one being a detailed study of the oscillatory galvanomagnetic effects in a single crystal of tin, at liquid helium temperatures. Thermomagnetic effects have also been shown to exist in tin but no quantitative analysis has been made of these.

The influence of hydrstatic pressure up to 2300 psi on Ettinghausen-Nernst effect and Hall effect in zinc has been studied at 4.2° K and a magnetic field of 2 to 11 kilogauss. The period (β^*/E_0) and the amplitude of the oscillations in Ettinghausen-Nernst effect have been found to depend upon pressure. The results are such that long period oscillations of 6.28×10^{-5} gauss⁻¹ decrease by about 5% when pressure is increased from 40 psi to 2300 psi whereas the amplitude of these oscillations increase with increasing pressure e.g. for an increase of 300 psi, there is about 10% increase in amplitude. This seems to contradict some previous results in zinc where an increase of pressure caused an increase in period and decrease in amplitude. There is no evidence of phase change with pressure within the experimental accuracy of

 \pm (.05) $\pi/2$. All the experiments in zinc were performed with the hexagonal axis parallel to magnetic field.

De Haas-van Alphen type oscillations have been discovered in the Hall effect, Ettinghausen-Nernst effect and thermoelectric power in tin. With the magnetic field parallel to the tetragonal axis, the period of the oscillations in H⁻¹ is 5.5 x 10⁻⁷ gauss⁻¹ for each effect. This is in good agreement with the period reported by Shoenberg for susceptibility oscillations. The measuring apparatus was sufficiently sensitive that oscillations in each effect could be clearly observed at fields as low as 10 kilogauss. About one hundred oscillations have been recorded in the range 10-17 kilogauss. In each effect, well defined oscillations are found to be superimposed on a large monotonic component. The oscillatory term in longitudinal effects (magnetoresistance and thermoelectric power) has been found to be much larger than that of the transverse effects (Hall effect and Ettinghausen-Nernst effect).

Measurements made at several temperatures from 1.2° to 4.2° K and fields from 10 to 18 kilogauss show the amplitude of the oscillations in each effect to be strongly dependent on temperature and field. By analyzing the temperature and field dependent data of magnetoresistance in light of Zil'berman's theory, Dingle temperature of 2.2° K has been estimated. From experimental data of the gross resistivity tensor S_{11} and Hall angle (tan ϕ), the conductivity tensors σ_{11} and σ_{21} have been evaluated. Field dependence of gross σ_{11} , σ_{21} , tan ϕ and conventional Hall coefficient R are found to be in close agreement with Zil'berman's predictions.

Microfilm \$2.50; Xerox \$6.00. 125 pages.

SPIN WAVES IN FERROMAGNETIC BINARY SYSTEMS

(L. C. Card No. Mic 59-3013)

Peggy Ann Holmes Dixon, Ph.D. University of Maryland, 1959

Supervisor: Dr. Ralph D. Myers

A theoretical investigation has been made of several ferromagnetic, binary systems using the method of spin waves. The purpose was to study the low temperature dependence of the magnetization of these systems.

A history of the monatomic spin wave theories has been presented. The mathematical techniques used by previous workers are reviewed. An approximate method of second quantization was selected as the most tractable approach to the problem considered here.

Two ordered binary systems were studied; a NaCl-type configuration having only one exchange interaction within the nearest neighbor approximation and a CaF_2 -type configuration having two exchange interactions within the same approximation. The energies of the NaCl-type system at low temperatures split into two bands, analogous to the results found for diatomic lattice vibration theory. The energies for the CaF_2 -type system split into three bands. The magnetizations calculated for these configurations followed the Bloch T^3 law of magnetization. The slopes of the magnetization vs. temperature curves were found to depend upon the exchange interactions, spin magnitudes, and the lattice structure.

A calculation of the effects of adding impurity atoms to a monatomic, simple cubic lattice has been made. It has been assumed that a very small number of impurities are added to the monatomic lattice such that the probability of clustering of impurities is negligible. A perturbation theory calculation has been made for the system. The magnetization calculated for this case is shown to be valid for all values of the exchange interaction which are expected for ferromagnetic materials. The result of adding impurities is that the coefficient of the T^{3/2} term is changed. Values for this coefficient are tabulated as a function of the relative exchange interactions and the impurity concentrations.

This impurity calculation has been extended to describe the magnetization due to disordering a NaCl-type binary system. The magnetization for such a system having ten per cent of its atoms disordered (A atoms on B atom sites and vice versa) has been compared with the completely ordered NaCl-type system. Less than a three per cent change in the coefficient of the T^{3/2} term has been found for the ratio of J'/J ranging between 2 and 0, which is the range expected for ferromagnetic materials. J refers to the exchange interaction between unlike atoms and J' to the interaction between like atoms.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

MEASUREMENTS OF RELAXATION TIMES IN A COPPER TUTTON SALT AT LIQUID-HELIUM TEMPERATURES

(L. C. Card No. Mic 60-1450)

Kenneth Leonard Schick, Ph.D. Rutgers University, 1960

Major Professor: Richard T. Weidner

Despite much work on relaxation processes involving electron spins in paramagnetic salts, many questions remain unresolved. The copper Tutton salts are of special interest because of their relatively long spin-lattice relaxation times and because experiments using low-frequency paramagnetic relaxation techniques have shown that these salts exhibit an anomalous behavior.

Previous work on some Tutton salts has indicated that, even when the electron resonance line shape is made up of a multiplicity of spin rackets, and is thus inhomogeneously broadened, the behavior of the line upon saturation is described in terms of the RF transition probability, W_{rf} , and the relaxation parameter, \mathcal{T} , by $\mathcal{T}\alpha$ [1 + W_{rf} (2T)]-1, which is the expression appropriate to homogeneous broadening. In the present experiment measurements were made of the relaxation time for various concentrations of Cu in CuK2(SO4)26H2O diluted with ZnK₂(SO₄)₂6H₂O using the data to fit this expression. The dependence of T on the temperature, the concentration of Cu ions, and the sample size was obtained using a steady-state microwave saturation technique with DC detection. The microwave frequency was 9600 mc/sec, and the DC magnetic field was applied along the crystallographic a axis. Sample sizes varied from 11 to 80 mgm. The paramagnetic Cu ions were diluted by substitution of diamagnetic ZN ions in concentrations with a ratio of CU to Zn ions ranging from 1/0 to 1/121.

Measurements of \mathfrak{I} were made in the temperature range 1.6° to $4.2^{\circ}K$.

The principal results are as follows:

1. For samples with no diamagnetic dilution, but differing in size by a factor of 5.5, it is found that varies inversely with the temperature. However, for samples less concentrated than 1/1.34, the temperature dependence of \mathcal{T} is considerably more rapid, \mathcal{T} being proportional to \mathbf{T}^{-n} where "n" is between 2.5 and 3.

2. The relaxation time, \mathcal{T} , exhibits a marked concentration dependence. Decreasing the concentration of paramagnetic ions yields shorter relaxation times; for the least concentrated sample, however, the relaxation time is about the same as for a concentration five times as great. At 4.2° K the relaxation time decreases uniformly as a function of concentration as the concentration varies from 1/0 to 1/25. For the most concentrated sample, \mathcal{T} is 16 times that of the 1/25 sample.

3. No size dependence is observed for the undiluted samples. On the other hand, for two samples with concentrations of approximately 1/1.5 and a size ratio of approximately three, there appears to be a small size dependence, the smaller sample having a relaxation time about 50 per cent that of the larger.

4. The absolute values of the relaxation times range from 0.025 to 0.40 seconds at 4.2°K, and are as long as one second at 1.6°K.

5. The measurements suggest that more than one relaxation mechanism may be operative in the liquid-helium temperature range.

Although the present measurements do not unambiguously indicate those relaxation processes which are operative, it appears that certain processes which do not dominate can be identified.

It appears that the relaxation time measured in the present experiment may be due to more than one mechanism. It is not clear whether the energy bottleneck occurs between the lattice and the bath or between the spins and the lattice.

Finally, recent experiments by Gorter et al., ¹⁹ using paramagnetic relaxation on various concentrations of Cu in $CuK_2(SO_4)_26H_2O$ diluted with $ZnK_2(SO_4)_26H_2O$ have shown that \mathcal{T} decreases as the density of paramagnetic ions decreases (in contrast to some other salts tested with the same equipment), and that the temperature dependence is considerably faster than T^{-1} . These are in agreement with our results.

Microfilm \$2.50; Xerox \$3.60. 63 pages.

DISLOCATION STRUCTURE OF ALKALI HALIDE WHISKERS

(L. C. Card No. Mic 60-1272)

William Joseph Spencer, Ph.D. Kansas State University, 1960

The dislocation structure of alkali halide whisker crystals may be obtained by x-ray techniques. The effect of heat cycling on the dislocation structure of these crystals is determined and the change noted in the dislocation structure of the whiskers is discussed as a possible mechanism for the loss of axial dislocations in

metal whiskers. To study the dislocation motion at high temperatures, a thermal etch technique is developed for large alkali halide crystals.

Whiskers of several types of alkali halides were grown by the method of Guylai. Whiskers grown by this method were carefully mounted on glass rods with duco cement. The crystals were then placed in a Weissenberg-type camera and several x-ray patterns were obtained. Rotation patterns of KI, KBr, KCl, and NaCl whiskers indicated that they all grew along the [100] direction. Following the work of Dragsdorf and Webb, Laue patterns of the whiskers were obtained and the Burgers vectors of the axial screw dislocations of these whiskers were determined. The Burgers vectors were also measured by the Weissenberg method and the results of both methods compared. Within experimental error the two methods gave the same result.

After the dislocation structure of the whiskers was determined, the whiskers were subjected to several treatments in an attempt to remove the axial dislocations. Two methods by which the dislocation could be removed at high temperatures are discussed. Calculations are made to show that it is highly improbable that the axial dislocations in alkali halide whiskers could glide out of the crystal in the manner discussed by Hirth and Frank. Applying the theory developed by Weertman and Amelinckx to the production of helical dislocations in alkali halide crystals, it was shown that the axial screw dislocations in whiskers of these crystals could climb and intersect the surface of the whisker producing an essentially dislocation-free crystal. Several of the whiskers which originally had a detectable dislocation were heated for a few minutes at 640° C to remove these dislocations.

Since whiskers which had an axial screw dislocation were found to sublime at a lower temperature than whiskers which did not contain a dislocation, it seemed likely that the surface intercepts of dislocations in large crystals could be shown by a thermal etch technique. Plates of NaCl cleaved from large single crystals were thermally etched for 20 to 30 minutes at 665° C. The surface pits were definitely shown to be due to dislocations.

The work done here, then, has shown that climb may also occur in whiskers. Climb of the dislocation in whiskers is surmised to be the reason dislocations are not observed in metal whiskers grown at elevated temperatures. In addition to climb in whisker crystals, dislocation motion is observed in large single crystals by thermal etching the surface of the crystals.

Microfilm \$2.50; Xerox \$5.20. 104 pages.

INFRARED PROPERTIES OF SEMICONDUCTORS

(L. C. Card No. Mic 59-6269)

William George Spitzer, Ph.D. Purdue University, 1957

Major Professor: H. Y. Fan

The absorption and reflectivity of a number of semiconducting materials have been measured in the infrared region of the spectrum.

The room temperature intrinsic absorption edge of

PHYSICS 4423

germanium and silicon have been measured to large values of the absorption coefficient. The interpretation of these measurements by using the model of direct and indirect transitions across the energy gap is given. The pressure dependence of the intrinsic absorption edge in germanium and silicon has been determined. The measurements indicate that in both materials the lattice dilation plays a minor role in the temperature dependence of the absorption edge. The influence of large impurity concentrations on the intrinsic absorption edge of germanium has also been investigated. An interpretation of the observed effect is given.

The absorption by free carriers in n-type germanium is measured for samples of various carrier and impurity concentrations. The measurements were made in the temperature range between 78° K and 450° K, and covered a wavelength region from 5 to 38 micron. The measurements are analyzed by using a theory of free carrier absorption derived by Fan and Fröhlich. At the high temperature end, the absorption is proportional to the carrier concentration as predicted by lattice scattering. At 78° K the absorption per unit carrier concentration consists of a constant part and a part proportional to the impurity concentration. The absorption increases with wavelength more rapidly at the low temperature. The frequency and temperature dependences of absorption in the various samples are in good agreement with the theory. Quantitative agreement can be obtained using an effective mass $m* \simeq 0.1 m$.

Measurements to 45 micron of p-type silicon failed to reveal any measurable absorption due to interband transitions within the overlapping valence bands. However, measurements of a number of n-type silicon samples of different carrier concentrations show a pronounced absorption band centered at ~ 2.3 micron at room temperature. The dependence of this band on carrier concentration and temperature suggests that electrons in the conduction band are being excited to a higher lying energy band.

Reflectivity and transmission measurements at different temperatures have been made on pure indium antimonide between 40 and 150 micron. The reflectivity measurements show a residual ray band near 52 micron. The degree of ionicity of the material is estimated from the data. Room temperature measurements also show a high reflectivity beyond 100 micron. This high reflectivity is shown to be due to the high absorption of the intrinsic concentration of conduction electrons.

By using reflectivity and absorption measurements in the region 5 to 35 micron, the effect of free carriers on the optical constants has been determined for n- and ptype germanium, silicon, and indium antimonide and n-type indium arsenide. The contribution of the free carriers to the electric susceptibility is obtained from the optical constants. A carrier effective mass, ms, is defined in terms of the susceptibility, and the significance of m s is considered for four different types of energy band structure. For the spectral region used, the experimentally obtained susceptibility, unlike the conductivity, is independent of the carrier relaxation time and satisfies the predicted wavelength dependence. The experimental values of m_s are compared with those calculated from data from other experiments. Good agreement is found for n- and p-type silicon, n-type germanium, and p-type indium antimonide. In p-type germanium the susceptibility due to transitions between the overlapping bands in the valence band is taken into account. However, the resulting $m_{\rm s}$, for a sample of $\sim 10^{19}~{\rm cm}^{-3}$ impurity concentration, is larger by a factor of 1,8 than that calculated by using cyclotron resonance data. In n-type indium antimonide $m_{\rm s}$ increases with carrier concentration. If $m_{\rm s}$ is assumed to be energy dependent, the shape of the conduction band calculated is consistent with previously reported measurements of the shift of the intrinsic absorption edge with electron concentration. In the case of n-type indium arsenide $m_{\rm s}$ differs from the effective mass reported from thermoelectric measurements, but agrees well with the value determined from the shift of the intrinsic absorption for an impure specimen.

Microfilm \$2.50; Xerox \$7.40. 158 pages.

A NUCLEAR MAGNETIC RESONANCE STUDY OF XENON

(L. C. Card No. Mic 60-1455)

Ralph Louis Streever, Jr., Ph.D. Rutgers University, 1960

Major Professor: H. Y. Carr

In this work xenon in the liquid and gaseous states has been studied by the methods of nuclear magnetic resonance. Natural xenon was used in this work. It has several isotopes, two of which have magnetic moments, Xe^{129} and Xe^{131} . The spin-lattice relaxation time T_1 was measured for the isotope Xe^{131} using magnetic resonance methods. In the measurements in the gas, standard pulse methods were used. In the liquid, T_1 was measured using a steady state free precession technique. The gas measurements were made over a pressure range of from 50 to 110 atmospheres. Over this region the relaxation time was found to be proportional to $\frac{1}{\rho^2}$ where ρ is the density of the gas. In the liquid the dependence of the relaxation time data could be accounted for by an activation energy for thermal motion of 0.6 ± 0.1 kilo cal per mole.

The values of T_1 measured ranged from 57 ± 2 seconds in the liquid at -101° C to 2600 \pm 600 seconds in the gas at a pressure of 48 atmospheres. The diffusion coefficient D at -74° was also obtained in an exploratory measurement using resonance methods and was found to be $0.4 \pm 0.2 \times 10^{-5}$ cm²/second. This value of D was used in the Bloembergen, Purcell, and Pound theory of relaxation to calculate T_1 at this temperature. In the liquid the measured values of T1 were found to be a factor of 100 smaller than would be predicted by simple dipoledipole theory of relaxation. At 30 atmospheres in the gas the extrapolated experimental value of T1 was found to be lower than that which would be predicted by a theory of dipolar relaxation in a low density gas by a factor of 1000. Part of this discrepancy may not be associated with the strength of the interaction but with the crudeness of the theory itself.

In the course of this work the shifts in the resonant field at fixed frequency for the xenon samples were measured. A density dependent shift was found. For a gas sample at 310 amagats, about 109 atmospheres, the field shift was found to be about 1 gauss in 8000 gauss with respect to the value at low gas densities around 30 atmospheres. The sign was such that the local field at the nucleus was increased as the density increased.

The shift may be due to the reduction in a large diamagnetic field shift of around 50 gauss at a field of 8000 gauss. This reduction may be due to the effect of neighboring atoms. If fluctuating local fields of the same size as the observed paramagnetic shift were postulated, the observed relaxation times could be explained to well within one order of magnitude and this may be a possible relaxation mechanism. Microfilm \$2.50; Xerox \$4.60. 90 pages.

PHYSIOLOGY

AN INVESTIGATION OF THE ROLE OF THE PITUITARY AND ADRENAL GLANDS IN THE ACTIVE TRANSPORT OF SODIUM ION THROUGH THE FROG SKIN

(L. C. Card No. Mic 60-1249)

William Richard Bishop, Ph.D. University of Oregon, 1960

Adviser: Bradley T. Scheer

The rate of the net influx of sodium ion (I_t) due to active transport in the isolated frog skin of Rana pipiens was measured with an adaptation of Ussing's short circuit device. This method utilizes the formula, $I = L_E E + V$. The external current (I_t) required to hold the potential difference across the skin (E) to 0 is equivalent to the rate of the active Na transport (V). Hence, $I_t = V$. Measurements of I with increasing values of E resulted in a linear regression for each skin. The slope of this line (L_E) , represents the conductance of the skin.

The skins of equal groups of sham-operated control and hypophysectomized animals were subjected to short circuit measurements weekly for a maximum of 6 weeks post-operative. Within 2 to 3 weeks, the mean Na $^+$ transport (\overline{X}_{I_t}) and resting potential (\overline{X}_{E_T}) values of the hypophysectomized groups dropped substantially below those of the accompanying controls. Subsequently, periodic measurements revealed a gradual increase (recovery) of hypophysectomized group \overline{X}_{I_t} and \overline{X}_{E_T} values toward those of the controls. In one case, the hypophysectomized group \overline{X}_{I_t} recovered completely and then surpassed that of the controls. There were no significant changes in slope over the entire period.

The skins of equal groups of sham-operated control, hypophysectomized and a number of different hypophysectomized-hormone injected animals were measured with the short circuit method each week for a maximum of 3 weeks. Those hormones injected daily were ACTH (1 and 2 USP units), gluco-corticosteroids (hydrocortisone, cortisone, both $1/2-1~\mu g$), mineral-corticosteroid (aldosterone, $10~\mu g$), and adrenal cortex extract ($1/2-1~\mu g$). Some animals received only one hormone, others received a combination of gluco- and mineralo-corticosteroids delivered in half-strength. ACTH injected groups revealed a complete recovery (100%) and later surpassed the controls. The corticosteroid combination averaged 81.5%

recovery. Aldosterone, 78.6%; hydrocortisone, 66.7%; adrenal cortex extract, 48.3%. Cortisone revealed no significant recovery in \overline{X}_{I_t} . These individual groups reached their maximum recovery at different times following which in most cases \overline{X}_{I_t} declined, possibly as a consequence of overdosage resulting from prolonged injection.

With the exceptions of the deletion of cortisone and the addition of a non-operated control group, the adrenalectomy experiments were carried out for 1 week in a manner similar to that of the hypophysectomy. The absence of a significant difference between \overline{X}_{I_t} values of the non-operated control and sham-operated control groups indicated minimal damage to the kidneys due to adrenalectomy. The \overline{X}_{I_t} of the adrenalectomized groups dropped to a greater extent than that of the hypophysectomized groups. ACTH had no direct effect on \overline{X}_{I_t} . The corticosteroid combination exhibited an average recovery of 75.4%. Hydrocortisone (70.8%) and aldosterone (67.7%) displayed essentially the same recovery pattern as in the hypophysectomy. Adrenal cortex extract averaged 52.9%.

The spontaneous, endogenous increase (recovery) in active Na transport following hypophysectomy may be due to a pituitary-independent mineralo-corticosteroid (aldosterone) which is known to increase the reabsorption of Na in the mammalian renal tubule. Carrying this analogy further, the frog skin may require a specific balance of gluco- and mineralo-corticosteroids to assist in the maintenance of its salt balance (Na^+/K^+) and total metabolism, carbohydrate, fat, and protein for the production of energy reserves, ATP, specific enzymes and/or carrier molecules essential for the efficient operation of the Na⁺ transport process. Exogenous combinations of most corticosteroids, and to a lesser extent individual gluco- and mineralo-corticosteroids may approach the true balance and partially restore the It rate. However, only ACTH will evoke a complete corticosteroid response and recovery. Excess of exogenous ACTH may effect an oversecretion of steroids resulting in exhaustion and a subsequent drop in It. Since the exact nature of the Na pump is unknown, the analogy does not extend beyond general metabolic implications.

Microfilm \$2.85; Xerox \$9.90. 218 pages.

THE SEPARATION OF CATION EXCHANGES FROM GLYCOLYSIS BY PHOTOSENSITIZATION IN RABBIT ERYTHROCYTES

(L. C. Card No. Mic 60-1424)

Thomas A. Borgese, Ph.D. Rutgers University, 1960

Major Professor: Dr. James W. Green

Brief exposures to visible light for periods up to thirty seconds, with added rose bengal, resulted in accelerated cation exchanges in rabbit erythrocytes. These rapid movements did not occur in control cells similarly treated but lacking the dye or in dye containing cells not subjected to the subsequent irradiation. The loss of potassium and gain of sodium following photosensitization were shown to be enhanced with increasing dye concentration. The effect of increasing the period of irradiation, while maintaining a constant dye concentration, was to increase the rate of cation exchange. This was a consequence of the change in light energy. When the total energy was held constant, varying the period of irradiation had no effect on the cation movements. Metabolism did not play a major role in the rapid movements since the temperature coefficients for potassium loss and sodium gain were close to one. In addition cells with and without added glucose showed practically the same loss of potassium and gain of sodium following photosensitization.

Associated with these cation exchanges was a decrease in glucose disappearance. This was not an important factor in either the rapid loss of potassium or gain of sodium since the dye treated non-irradiated cells which showed a similar reduction in glucose disappearance did not exhibit the rapid exchanges. Experimental evidence suggested that the effect was at the cell surface and a Lineweaver-Burke plot indicated that glucose entry might be blocked as a result of some competition between

glucose and dye molecules.

Initially cation movements were entirely passive. At the termination of the experiments both active and passive fluxes were operating. Calculations indicated that only 10% of the total flux was attributable to an active process while the remaining 90% was due to passive movements.

Microfilm \$2.50; Xerox \$6.20. 126 pages.

THE INFLUENCE OF ESTROGENS ON PROTEIN METABOLISM IN THE ADULT MALE RAT

(L. C. Card No. Mic 60-1433)

Homer Robert Harding, Ph.D. Rutgers University, 1960

Major Professor: Dr. James H. Leathem

Male Long-Evans strain rats, weighing 350 to 420 grams, were placed on a synthetic diet containing 18% casein and divided into two groups. The first group was given 0.1 mg. of stilbestrol for 20 days and fed ad libitum. The rats of the second group served as controls and were pair-fed to the first. Eight rats from each group were sacrificed at the end of the 20 day injection period. Organ

weights of pituitary, thyroid, adrenal, spleen and seminal vesicle were taken. Heart, liver, kidney, testes and gastrocnemius muscle were weighed and dried for protein and lipid determinations. Rats from the same colony maintained on Purina fox chow and of the same age were sacrificed for comparison of organ weights.

Rats of both injected and pair-fed control groups were castrated at the end of stilbestrol treatment and nitrogen and phosphorus balances determined for 32 days post-injection. The rats were then sacrificed and organs taken for analyses of water, protein and lipid content.

The estrogen treatment enhanced the retention of nitrogen in the post-injection period. Castration did not influence the retention of either nitrogen or phosphorus.

Rats treated with stilbestrol had greater liver and kidney weights in proportion to body weight than did pair fed controls. Liver and kidney protein concentrations of the estrogen treated rats were comparable to those of pair fed controls. Testes protein was reduced, while testes lipid exhibited a concomitant increase. At the end of the 32 day post-injection period organ weights, and total protein and total lipid increased in relation to the increase in body size.

Nitrogen balances were determined on adult male rats receiving 0.1 mg. equilin daily for 20 days and continued for 32 days post-injection for comparison with rats treated with 0.1 mg. stilbestrol. The loss of nitrogen during the injection period could be related to reduced food intake. Nitrogen retention was not enhanced in the post-injection period. Rats injected with stilbestrol in amounts estrogenically equivalent to 0.1 mg. of equilin, e.g. 3.3 μ g., elicited nitrogen balance patterns similar to rats injected with equilin. Microfilm \$2.50; Xerox \$5.80. 117 pages.

CHEMICAL PROPERTIES OF THE OLFACTORY TISSUE

(L. C. Card No. Mic 60-1409)

Richard T. Jackson, Ph.D. The Florida State University, 1960

A yellow-brown pigment colors the olfactory tissue of most vertebrates. The chemical nature of the pigment is imperfectly known, but it has been implicated in a theory of olfactory stimulation. The fat-soluble pigment has been isolated from rabbits, dogs, and opossums. Fractionation of this olfactory pigment discloses the phosphatidic acid and lecithin fractions to contain all the pigment. Comparison of the properties of this pigment with other phospholipids leads the author to believe that the yellow-brown color is due to auto-oxidation products of phospholipid origin such as hydroperoxides, epoxides, and aldehydes. The degree of pigmentation could not be influenced by various nerve transections. Rabbits were subjected to unilateral transection of the cervical sympathetic, the ethmoidal and olfactory nerves. These procedures had no obvious effect on the degree of pigmentation. The degree of pigmentation varies slightly within a species and between species. The author could not distinguish between the epithelia of dog, cat, rabbit, rat, sheep, and calf on the basis of pigmentation. The epithelia of frogs, turtles, and alligators is a less saturated yellow than the

higher vertebrates. There was no difference in pigmentation between albino and pigmented rabbits and rats. The questionable relationship between albinism and anosmia may have another basis. Because the pigment is a mixed, unstable, oxidation product, histochemical localization should only be attempted with caution.

The oxygen consumption of the highly innervated and pigmented olfactory tissue was measured and found to be very similar to the oxygen consumption of adjacent respiratory tissue. Olfactory tissue was positive for non-specific esterase, whereas adjacent respiratory tissue was negative. Microfilm \$2.50; Xerox \$3.00. 57 pages.

AN INVESTIGATION OF REGIONAL CEREBRAL BLOOD FLOW AND ITS RESPONSIVENESS TO CERTAIN PHYSIOLOGICAL AND PHARMACOLOGICAL AGENTS

(L. C. Card No. Mic 60-1312)

Francis Marion Knapp, Ph.D. University of Southern California, 1960

Chairman: Professor Hyman

The circulation of the brain has been the subject of numerous investigations over the years. Because of anatomical peculiarities, the bulk of information concerning the cerebral blood flow has been based on measurement of total blood flow to the brain. Due to the heterogeneous nature of the brain, however, no generalized concept for cerebral blood flow should be postulated on the strength of these results. The diversity of tissue suggests a variation in blood flow through the several regions to meet metabolic requirements.

An adequate appraisal of blood flow through the different regions of the brain is presently lacking. Such information would be of considerable aid in describing the normal blood flow rates, as well as determining the responsiveness of the cerebral vasculature to various stimuli.

Using the tissue clearance technique, proposed by Kety for the determination of muscle blood flow, values have been obtained for blood flow through the two basic types of brain tissue (gray and white matter) in response to a select group of physiological and pharmacological agents in cats and rabbits. The method provides for relatively long-range estimations of cerebral blood flow with minimal trauma to the experimental animal.

To determine the validity of the technique, simultaneous internal carotid artery blood flow determinations have been made on a group of rabbits with the vertebral arteries occluded, the carotid flows being taken as a representative index of tital blood flow to the brain. Results indicate that the clearance technique is adequate as a semiquantitative measurement of regional blood flow in the brain. Shifts in carotid flow and the clearance rate of isotope (I¹³¹) occurred concomitantly and in the same direction, although not of the same magnitude, the clearance values being generally somewhat smaller.

In the resting state the clearance rate from the caudate nucleus (gray matter) approaches a value twice that from the internal capsule (white matter), demonstrating a regional difference in blood flow. The clearance rate from the caudate nucleus also approximates values for internal carotid artery flow, as anticipated from the preponderance of gray matter in the brain.

Of three vasodilator agents used in this study, carbon dioxide was superior to Arlidin and Hydergine in increasing cerebral flow. This is evidence for the importance of carbon dioxide in the intrinsic control of the cerebral flow, since it is one of the principal metabolic by-products.

Histamine is a vasoconstrictor in the brain in the dosages used in these experiments.

The action of these agents demonstrates the responsiveness of the cerebral circulation. Earlier work suggested that the cerebral blood flow is primarily dependent upon systemic arterial pressure, the vasomotor activity in the brain being controlled within rather narrow limits. The results obtained in this work indicate that neither case is true under normal circumstances. Changes in blood flow are apparently the result of shifts in the cerebral vascular resistance, and not alterations in blood pressure. Quantitatively, alterations in the blood flow are of the same magnitude as those elsewhere in the body, demonstrating that the responsiveness of the cerebral circulation is not narrowly confined. The cerebral vascular system appears fully capable of producing any alterations in blood flow to the various areas of the brain required to maintain the integrity of the brain.

Differences in flow in the various regions of the brain necessitate a re-evaluation of the data based on total blood flow to the cerebral tissue.

Microfilm \$2.50; Xerox \$6.20. 126 pages.

A STUDY OF THE INFLUENCE OF LIGHT AND DARKNESS UPON THE REPRODUCTIVE PERFORMANCE OF THE FOWL

(L. C. Card No. Mic 60-1438)

Raino Kullervo Lanson, Ph.D. Rutgers University, 1960

Major Professor: Dr. Paul D. Sturkie

A study has been made of the effect of light and darkness on the time of oviposition, rate of egg production, food consumption, and egg and body weights of chickens. A series of tests involving continuous, intermittent, and flashing light regimens were conducted to determine the effects of darkness as a means of controlling the time of oviposition. The lengths of the continuous dark periods per 24 hours were 0, 1 1/4, 2 1/2, 3 3/4, 5, 10, and 10 1/4 hours. A minimum period of 1 1/4 to 5 hours of darkness starting at 5 pm, 1:30 am, or 1:30 pm was sufficient to alter the time of oviposition so that egg production began approximately 8 hours after the onset of darkness. The weighted mean egg for both pullets and hens was laid from 13 to 16 hours after the onset of darkness.

In a second series of tests 10 1/2 hours of continuous light was provided from 6:30 am to 5 pm and 7 periods of 1/2 hour each intermittently between 5 pm and 6:30 am. The time of oviposition could be altered by as much as 6 hours by the placement of the seven 1/2 hour periods.

Darkness did not have an accumulative effect in

controlling the time of oviposition when 1/2 hour intervals of darkness were separated by 1/2 hour intervals of light.

It is postulated that light and darkness per se do not control the time of oviposition, but that it is the absence of activity which establishes the diurnal rhythm of egg lay. There is a rather consistent time interval between the onset of darkness (and resulting sleep) and the time that the first egg for the day is laid. It appears that sleep or inactivity is the stimulus which induces the release of luteinizing hormone.

When a change is made in light regimens, both pullets and hens are able to adjust quickly their egg laying behavior to the new regimen. The change in time of lay is made primarily between sequences, and at least three days must elapse before birds are able to alter the time the C1 egg is laid.

No significant differences were noted between birds (pullets and hens) receiving eight different light regimens. providing an average of 14 hours of light and 10 hours of darkness, in respect to egg production, food consumption,

feed conversion, and body weight.

Pullets were able to lay at approximately the 50% level when provided 24 hours of flashing light, 19 hours of flashing light plus 5 hours of darkness, and 15 minutes of light each hour. The total hours for each of the preceding regimens was 10, 4, and 6 hours respectively. Despite the limited hours of total light, there was no significant differences in food consumption between pullets receiving these three light regimens and those birds receiving the conventional 14-hour day.

Pullets generally start to lay earlier in the day and continue to lay later in the day than do hens. Pullets also lay their weighted mean egg for the day at a slightly earlier hour than do hens.

Both hens and pullets receiving flashing light plus continuous light produced significantly smaller eggs than birds on other light regimens.

The largest eggs for the day are the first ones laid despite the fact they may be laid in the evening instead of during the customary morning hours. Egg weights decrease between consecutive eggs in short sequences.

Microfilm \$2.50; Xerox \$5.60. 114 pages.

EFFECT OF ADRENAL STEROIDS UPON SURVIVAL OF RATS SUBJECTED TO TOURNIQUET SHOCK

(L. C. Card No. Mic 59-5209)

Melville W. Osborne, Ph.D. Princeton University, 1959

Tourniquets applied to both hind limbs of intact, nonadrenalectomized rats for a period of 6 hours resulted in the death of 197 control animals, thus inducing a mortality of 100 per cent. All of the controls died in less than 24 hours after release of the constrictions. Placement of 6 hour tourniquets results in a typical shock-like state. The common, well authenticated, physiological changes associated with this syndrome include hemoconcentration, marked dimunition of blood volume, vasoconstriction, lowered body temperature, and massive edema of the legs due to local loss of fluid into the injured area, eventuating

in death from circulatory collapse due to lack of sufficient circulating fluid volume.

Since a striking similarity exists between the metabolic and circulatory derangements in both shock and adrenal insufficiency, following removal of the adrenal glands, it has long been considered not unlikely that adrenocortical steroids might prove to be an effective form of therapy in types of shock other than that due to adrenal failure. Early work failed to produce conclusive evidence of the efficacy of adrenocortical steroid preparations in ameliorating the shock state. The adrenocortical preparations used in these early studies were crude adrenocortical extract and the synthetic mineralocorticoid, desoxycorticosterone. Recent advances in the synthesis of adrenal steroids and preparations of extremely potent analogs of the natural hormones led the present writer to test the efficacy of the new compounds on shock induced by limb tourniquets.

Various combinations of adrenocortical steroids were used, both singly and in combination. Eight groups of rats were tested, each group receiving a different type of steroid therapy. The combination of the 3 adrenocortical steroids, 6-methylprednisolone (4 mg.), 9 α -fluorotriamcinolone (4 mg.), and 2-methyl-9 α -fluorohydrocortisone (2 mg.), solubilized in 2 cc. of fluid and injected intraperitoneally as a single injection just before releasing the constrictions, proved to be the most effective steroid since 64 per cent of the shocked rats survived the critical 24 hour period during which all non-treated controls succumbed. Twenty-four per cent survived 48 hours and 15.5 per cent survived 72 hours. All surviving animals were sacrificed at the end of 72 hours since gangrene of the limbs may supervene. The water soluble adrenocortical steroid preparation 2-methyl-9 α-fluorohydrocortisone hemisuccinate (4 mg. in 2 cc. distilled water) proved to be the most effective single adrenocortical steroid employed in these survival studies since 50.9 per cent lived longer than the critical 24 hour period, 33.9 per cent survived 48 hours, and 14.9 per cent survived 72 hours, after which they were destroyed.

Adrenalectomized rats, which are highly susceptible to even mild stress, were exposed to 6 hour tourniquet application and the combination of the 3 adrenocortical steroids found to be most effective for survival of the stressed, intact rats was then tested for therapeutic efficacy. This steroid combination enabled 16.1 per cent of adrenalectomized animals to survive the critical 24 hour period, 11.3 per cent survived 48 hours, and 6.4 per cent survived 72 hours.

A group of rats were cross stressed, i.e., "conditioned," by using tourniquet shock as the primary stressor and mild dehydration stress, by removing the drinking water from 5 p.m. one day to 8 a.m. the following day for 30 consecutive days, as the secondary stress. The conditioning process resulted in survival of 63.4 per cent of the rats for the first critical 24 hour period, 37 per cent survived for 48 hours, and 26 per cent survived for 72 hours.

The evidence strongly indicates that use of potent adrenocortical steroid preparations on rats exposed to a uniform, standardized shock such as that resulting from tourniquet application to the hind limbs, and removal of the constrictions after 6 hours, results in a significant per cent of recoveries. As was mentioned previously, this procedure when tested on intact, non-adrenalectomized animals (197 rats) results in 100 per cent mortality within less than 24 Microfilm \$2.50; Xerox \$4.40. 82 pages.

POLITICAL SCIENCE

POLITICAL SCIENCE, GENERAL

POLITICS AND GEOGRAPHY IN POSTWAR GERMAN CITY PLANNING (A FIELD STUDY OF FOUR GERMAN CITIES: HANNOVER, COLOGNE, KIEL, AND TRIER).

(L. C. Card No. Mic 59-5182)

Ernest Thomas Greene, Ph.D. Princeton University, 1958

The reconstruction of Europe's cities has been one of the most spectacular events in postwar Western Europe. This dissertation compares four cities in West Germany, Hannover, Cologne, Kiel, and Trier, and attempts to find why some cities were better able than others to replan and to reconstruct, and what can thereby be learned for planning in general. Hannover shows how to plan and Cologne how not to plan. Kiel, in financial straits similar to Cologne, shows how a city can make the best of a discouraging situation. Our study is based on interviews, documents, interpretive writings, and first-hand observation in the cities concerned between June 1957 and July 1958.

After thirteen years of reconstruction, the evaluation of some of the achievements seems particularly appropriate. Focal point for the study will be the changes in the geographical layout of these cities, and the process by which the relevant political decisions were reached. Political decision, in influencing the allocation of space, rarely had a free hand in postwar Germany in spite of widespread destruction apparent in 1945.

The introduction of the dissertation discusses a number of the imperatives that confronted all planners in West Germany, regardless of their location. Such were the widespread popular apathy as a heritage of dictatorship, the absence of a German state in the years 1945-48, the currency reform and the remarkable economic recovery, and the influx of refugees, to mention only a few.

For each of the four cities, there is a brief general introduction on the history and location of that city, followed by discussion of the story of the occupation and early postwar planning, the legal environment of planning, and the history of general planning until the completion of the master-plans. One or two detailed case studies have been chosen for each city: for Cologne the Griechenmarkt-viertel, a residential section, and the Nord-Süd-Strasse, for Hannover the Kreuzkirche project and planning for the center of the city, for Kiel the downtown shopping district and the Holtenauer Strasse project, and for Trier the construction of a street designed to relieve congestion in the center of the city. The period considered is from 1945 to 1958.

Neither cost nor legal tools are the all-important consideration in city planning. Kiel was able to defy a negative verdict that would have been dictated had the planners simply looked at the financial statements of the city or taken stock of the grim economic outlook in 1945. An en-

ergetic town planner could convince the City Council and the citizens to adopt measures costing a great deal. Some of the most successful reconstruction projects, including the Kreuzkirche district in Hannover, were achieved without the help of the state reconstruction laws.

Timing in planning is of utmost importance. If plans take too long, if they lag and do not result in concrete achievements, the public may become resigned to failure, an attitude which in turn makes failure inevitable. When gradual accomplishment of plans is emphasized, plans that seem to be too expensive suddenly may become possible.

The city planner himself was able to lead the Council and its committees, and the general public as well, the more so as other participants in the planning process looked to him for leadership. Leadership in planning and reconstruction must be continuous, and it must come from one source. Where it was lacking or divided, the city inevitably came out the worse. We conclude that leadership is the key to planning in reconstruction.

Microfilm \$4.70; Xerox \$16.65. 367 pages.

WILLIAM O. DOUGLAS-INDIVIDUALIST; A STUDY IN THE DEVELOPMENT AND APPLICATION OF A JUDGE'S ATTITUDES.

(L. C. Card No. Mic 60-1475)

John W. Hopkirk, Ph.D. Princeton University, 1958

William O. Douglas is one of the most controversial of our Supreme Court Justices, frequently drawing public notice for the manner in which he expresses his opinions on public policy both on and off the bench. This study details some of the ways in which those opinions have been shaped by the Justice's background, both during his youth and in the course of his professional training and apprenticeship for the position of Associate Justice of the United States.

On the Court Justice Douglas often gives expression to a strongly individualistic philosophy which appears to have strong roots in his boyhood experiences. Among the elements of this individualism noticeable in his early years are a driving energy to surpass others, brought out by the need to overcome both poverty and physical handicaps, a faith that individual effort can be rewarded, based both on observations of the thriving land in which the Justice matured and on his own personal success. In the spirit of Western Populism his individualistic philosophy was tempered by the view that the government has a duty to help those who strive to help themselves, to give them aid both in conquering the forces of nature and in their struggles against powerful economic interests which might otherwise overwhelm them.

Douglas' legal training placed great emphasis on realistic analysis of the manner in which legal institutions were actually functioning, upon the effects they were actually having both upon private litigants and upon the political, economic, and social processes of the country. It emphasized the policy-making role which judges were playing in our society, whether they wished it or not. These factors explain a great deal about the Justice's outspoken attention to public policy as it is created by individual decisions involving individual litigants.

At times Justice Douglas' legal approach proves most effective in supporting policy which originates with other branches of government, Congress, federal administrative agencies, or units of state government. We see this in the areas of anti-trust litigation, administrative regulation and interstate relations. It is particularly true in the field of corporate reorganization where the Justice had helped to originate much of the policy while working for the Securities and Exchange Commission.

On other occasions the policy with which the Justice appears to be concerned seems more uniquely his own. Among cases illustrating this are those in which he seeks to restrict the freedom of the executive, administrative agencies, and the legislature. Of particular note in this respect are many of his opinions in the fields of free speech and criminal procedure.

A definite shift in Douglas' approach is noticeable since he joined the Court. While he still employs the techniques of "functional" analysis of legal problems, his concern seems to be less focused on methods of efficient law enforcement, more on the need to protect the individual from abuse of organized power, either public or private. At times he expresses his disapproval of governmental policy in opinions charged with emotional feeling. While the Justice might increase the strength of his judicial position by maintaining a more critical control over his emotions in pronouncements on topics where he feels strongly, his work does convey an important message, needed on the contemporary scene, of what American liberal democracy should mean for the individual, both at home and abroad.

Microfilm \$7.45; Xerox \$26.55. 588 pages.

LOCAL GOVERNMENT AND ADMINISTRATION IN THAILAND: A STUDY OF INSTITUTIONS AND THEIR CULTURAL SETTING.

(L. C. Card No. Mic 60-825)

Frederick James Horrigan, Ph.D. Indiana University, 1959

The system of local government and administration in Thailand is the subject of this study. Since many of the political and administrative forms explicit in this system are borrowed from the West, it is the objective of this thesis not only to describe and analyze sub-national institutions of government but to assess the influence of the indigenous social structure and culture on these imported Western forms.

Essential to an understanding of modern Thai government is an appreciation of the nature of the traditional absolute monarchy in Thailand and the great continuity of influences derived from this tradition. The absolute state of Thailand was one of extraordinary power, centered in the person of the king; the state monopolized societal

leadership through a concentration of vital functions implicit in the monarch's role of semi-devine ruler, military leader, and economic overlord. Reinforcing the power of the king in these vital areas, a variety of political, administrative, legal, social, and psychological conventions vested unchecked control of the state in the king and in the bureaucracy which served him, and effectively leveled non-governmental forces in society.

The monolithic structure of absolute government forged a single centered society which provided the institutional setting for successive waves of administrative and political innovations adopted largely in response to the military, economic, and ideological impact of the West beginning in the nineteenth century. Alone among Southeast Asian nations, Thailand evolved a modern state structure in the absence of colonial impositions or broad social demands.

Local government and administration has undergone an evolution in structure and functions which corresponds to reforms at the national level. The traditional system of provincial government consisted of a complex of vassal states and loosely controlled provinces administered by non-salaried, semi-independent officials or petty princes. This system was swept away in the late nineteenth century and replaced by centralized administrative control; local self-government was introduced to Thailand in 1933 by its first constitutional government; and recent attempts to democratize provincial government were ostensibly based on Western ideology.

Contemporary local government and administration has three distinctive patterns; a territorial administration composed of 71 provinces (changwads) sub-divided into 448 districts (amphurs) managed and staffed by officials of the central government; a pattern of traditional village government greatly weakened by long subservience to officials and virtually incorporated into the territorial administration; and local self-governing entities in various stages of development governed by a concert of locally elected and central government officials, subsidized and carefully supervised by the central government, and employed largely as its agents.

The provincial and district units of the territorial administration are administered by officials of the Ministry of Interior who are recruited, trained, and controlled according to standards and practices adopted from Western systems and administered with reasonable efficiency. The importance of informal relations and a limited public responsibility within the bureaucracy reflect the persistence of traditional administrative mores. Democratic institutions at the provincial level, in the municipalities, and in small urban and village environments are distorted in operation because of a tradition of societal leadership from the national level, by bureaucratic domination, and lack of public interest.

The governmental system in Thailand, including national, provincial, and local institutions, is essentially indivisible since the cultural setting and social structure combine to produce a state stronger than society. The state in modern Thailand is fundamentally unchecked by actual societal forces. In this respect it is the direct descendent of the traditional government of Old Siam, and heir to the single centered social structure shaped by absolutism. Western administrative techniques have been adapted and reinterpreted successfully to serve the rational purposes of the state, but democratic institutions borrowed from the pluralistic societies of the West are

heavily distorted in the absence of a foundation of the nongovernmental forces and traditions of self-government on which they rest in the Western societies.

Microfilm \$4.60; Xerox \$16.20. 360 pages.

SPENCER'S IMPACT ON AMERICAN CONSERVATISM, 1870-1912.

(L. C. Card No. Mic 59-6069)

John D. Molloy, Ph.D. University of Cincinnati, 1959

Herbert Spencer's political philosophy had great appeal to American conservatives during the period 1870-1912. His ideas were welcomed by leading conservatives who saw in Spencer the most profound thinker of the age.

Many studies already have been undertaken of Spencer's political philosophy. None, however, has been done in the area of his impact on particular American conservative elements. The present effort is such a study.

This dissertation is concerned with Spencer's impact on American business, the Republic party, organs of American government itself, leading conservative intellectuals, and the American clergy.

American businessmen welcomed Spencer's doctrines because he provided them with a rationale with which to explain their financial success and justify whatever means they might use to acquire wealth. The leading financial baron of 19th century America, Andrew Carnegie, was Spencer's most devout disciple.

Spencer was popular with Republican leaders. Troubled by such "undesirable elements" as Populists, Bryanites, Free Silverites and Democrats, Spencer supplied ammunition with which the Grand Old Party could combat would-be reformers. Spencer's philosophical principles of Man Versus the State were particularly popular with GOP figures, who in 1916 sponsored a new edition as a protest against Wilsonian New Freedom.

American government itself was affected by Spencerian theory. The principle of limited action in government, best expressed in Spencer's classic essay, "Over-legislation," apparently was tailored for Republican presidents, who with the exception of Theodore Roosevelt, followed a theory of vigorous inaction. The U.S. Supreme Court wrote Spencerian principles into several of its decisions. A case in point is Lochner v. New York, in which Justice Holmes, dissenting strongly from the majority decision which invalidated a state maximum hour law, attacked his colleagues for writing Spencer's Social Statics into their interpretation of the 14th Amendment. Justices Field and Brewer were Spencer's most important judicial disciples. American legislators attended, in representative numbers, a testimonial dinner given Spencer during his triumphal tour of the United States in the fall of 1882. Several of them wrote articles praising Spencer and his theories.

American universities, particularly in the east, welcomed Spencer's teachings. At Yale, Sociologist William Graham Sumner promoted Spencerian dogmas. At Harvard, John Fiske was equally active.

Many American clergymen accepted Spencer. Their critics complained that it was the doctrine of Social Darwinism, rather than that of Christianity, that was being preached.

Protestant clergymen Henry Ward Beecher, Russell Conwell, and William Lawrence equated wealth and virtue, poverty and sin, without much regard for logic. The American Catholic church was not untouched by this conflict. The papal encyclical, Rerum Novarum, by Leo XIII, was written at the suggestion of American James Cardinal Gibbons, who urged the Vatican to define the church's position on the condition of labor after a heated dispute had rocked the New York diocese. Archbishop Michael Corrigan excommunicated one of his priests, Rev. Edward McGlynn, for refusing to obey an order to refrain from preaching the doctrines of Henry George. Fr. McGlynn considered George's Single Tax theory the answer to the needs of the poor of his parish.

The surging tide of Progressivism, economic, political, and social reformers, the articulation of dissent by labor, agrarian and intellectual groups, and the leadership of Presidents Theodore Roosevelt and Woodrow Wilson all were important factors in the decline of Spencerian ideas.

Microfilm \$3.35; Xerox \$11.70. 258 pages.

THE EXPERIMENTAL STUDY OF POLITICS: THE CONTRIBUTION OF SMALL GROUP EXPERIMENTS IN LEADERSHIP TO THE UNDERSTANDING OF POLITICAL LEADERSHIP.

(L. C. Card No. Mic 59-5236)

Sidney Verba, Ph.D. Princeton University, 1959

Political science has recently shown interest in the study of small groups. An analysis of the literature shows that small groups play significant roles in the political system. They are the locus of decision-making as well as a major influence on the political attitudes and behaviors of their participants. They may be formal or informal, supportive or dysfunctional in relation to the political system.

This study attempts to evaluate the usefulness of laboratory studies of experimental small groups for the study of political science. Particular emphasis is placed on the problem of extrapolating from findings in the experimental laboratory to on-going political situations. Certain aspects of the leader-follower relationship as studied in small experimental groups are analyzed in order to see their connection to similar relationships in on-going social and political situations.

The attempt to achieve precise control in the small group laboratory may lead to a sacrifice of relevance. A unique "laboratory culture" may be created from which it is difficult to extrapolate to on-going social situations. The special characteristics of this "laboratory culture" can be found in the membership of the groups, the observation techniques and the setting of the experiment. Certain convergences in the conceptual schemes and theoretical systems applied to both the small group and the larger social system suggest that such connections can be made if the unique characteristics of the experimental situations are recognized and considered. Attempts to increase the relevance of experimental studies by simulating on-going situations in the laboratory or by experimenting in field situations are also discussed.

Small group experiments in leadership and studies of

political leadership are compared. The advantages of the former lie in the functional definition of leadership used. Similar equilibrium problems are found to face the leader of the small experimental group and the leader of the ongoing group or organization. But the resolution of the problems differs. Leaders in both types of system must maintain equilibrium between instrumental activities and socio-emotional satisfaction of the group members. Equilibrium in the small group is found to be maintained by the development of two leaders, the instrumental and the socioemotional. In on-going groups such a bifurcation is not necessary. This is due to the existence of legitimate leadership based upon normative expectations. The absence of such expectations in the experimental group is traced to the unique laboratory situation. A similar comparison between the two systems is made in connection with the leader's relationship to the norms of the group. Experimental studies of these problems are found to increase our understanding of such relationships in on-going systems even in those cases where the experimental situation differs from the on-going system.

The small group studies of democratic and autocratic leadership are also considered. The special characteristics of the small group concept of democratic leadership and some pitfalls in attempts to generalize from the small group experiment to more complex social systems are discussed. In particular the assumption of a harmony of interests in complex social systems is questioned. The generality of the findings of these studies is also questioned. Cross-cultural studies are suggested as one means by which the generality of the participation hypothesis could be tested.

Microfilm \$4.55; Xerox \$16.00. 353 pages.

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

THE DEVELOPMENT OF LOCAL GOVERNMENT IN UGANDA: A COMPARATIVE APPROACH.

(PARTS I-III)

(L. C. Card No. Mic 59-1551)

Fred G. Burke, Ph.D. Princeton University, 1958

Great Britain is currently attempting to develop in its African territories a democratic system of local government based upon the English model. In Uganda, this program is seen as a requisite to an independent and democratic nation-state. However, Uganda is not one nation but rather is composed of a complex of tribal nations, each with its own peculiar culture and forms of traditional political organization.

In most instances the new local government areas coincide with tribal entities which, for historical and social reasons, are not perceived by the Africans as local authorities according to the English model. In other areas of Uganda the local government unit encompasses a number of small and antagonistic tribal groups. The English system of local government is being developed uniformly throughout Uganda. The problems encountered in implementing this system vary from one district to another.

This study seeks to analyze the development of local governments in Uganda in terms of a comparative method. The analysis in turn serves as a test of the method. The approach selected is a functional one and the frame of reference is the local political system. For the purposes of this study it was necessary that the method not only be capable of comparing Uganda traditional and transitional local governments, but it was also required that the method make possible comparison of traditional and transitional African political systems with those of highly developed western states. In order to facilitate comparative analysis of this nature recourse has been had to a functional approach whereby the phenomena researched and analyzed are a selected aspect of social action rather than local government institutions. At the most general level the method postulates that in any local political system authority and responsibility are allocated with the object of coping with problems of locality order and integration.

Variations in time and place, with respect to the manner in which authority and responsibility are allocated, were researched with reference to five analytical structures. An attempt has been made to correlate structural variation with certain environmental and social factors and to formulate a tentative typology of local political systems.

Uganda, in common with other African territories, is undergoing a period of rapid social, economic and political change. The local government system currently being implemented is designed to provide a means for coping with new problems arising as a consequence of change. However, many traditional problems persist for which the new political forms are frequently inappropriate. Under certain conditions and in certain areas, the indigenous political systems continue to cope with traditional problems. In some areas the traditional political systems have largely disappeared whereas in other areas elements of the traditional system have been adopted to cope with the new problems.

The rapidity and scope of the change has been accompanied by the imposition of political structures with respect to problems which are yet unrecognized by the local inhabitants; by instances of disintegration and disorder with respect to local problems for which organized means of solution do not exist and by the informal evolution of political structures based upon both the traditional and western systems.

Microfilm \$8.00; Xerox \$28.60. 632 pages.

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

PUBLIC RELATIONS POLICIES AND PRACTICES OF FEDERAL DEPARTMENTS AND AGENCIES

(L. C. Card No. Mic 60-844)

Joseph Willard, Ph.D. Indiana University, 1959

Supervisor: Professor Joseph Kingsbury

This is a comprehensive survey of the public information practices of Federal departments and agencies, with particular emphasis on the role of the departmental information offices as an instrument of internal control. In addition, this study examines the external forces--Congress and the mass media--which condition and limit public relations efforts.

The dissertation is based on material obtained from personal interviews with information officers, direct observation of their activities, and from both published and unpublished documentary sources. The subject is approached from a point of view that takes into account the peculiarities of the American political system, and the manner in which the system imposes conflicting demands on a bureaucracy which is answerable both to the Executive and to the Congress.

Government public information programs are designed primarily to serve the needs of the public in obtaining information about the operations of the bureaucracy, as well as for imparting specialized information to selected publics—farmers, veterans, regulated interests, and so on. Also taken into account is the use of "publicity" to gain public support for established and accepted programs, such as bond drives, recruiting efforts, and the like. The less legitimate uses of public information, program promotion, "management of the news," political press agentry, and defensive tactics, are seen to be largely derivatives of the "sanctioned" information programs.

Congressional attempts to distinguish between proper and improper publicity activities have not been particularly fruitful. Statutory prohibitions against improper publicity, appropriations riders and limitations on information funds, and other formal means to control departmental publicity efforts have been less successful than informal directions from influential member of Congress. Officials are hesitant to ignore these warnings, although they do not have the force of law, realizing that to do so would merely antagonize the Congressmen, and more drastic action against their organizations might ensue.

The relationships between the information offices and the mass media are treated in considerable detail, with the latter viewed as an extension of the departments' public information machinery. Government departments rely largely on the help from the mass media in reaching the public. The adequacy of public affairs reporting in the mass media is seen to be dependent upon (1) the willingness of the press to provide adequate coverage to "hard news;" and (2) whether the press is able to obtain information from Government. In connection with the latter, the arguments for "freedom of information" are considered in relationship with the opposing assertions which call for permitting administrators to exercise discretion in releasing information to the public. There are inherent dangers that administrators might abuse discretionary power and permit only the release of information suitable to their purposes. The press has been successful in fighting off excessive restrictions by calling on friends in Congress for assistance against bureaucratic withholding policies. The Moss inquiry was one such episode that administrators will not soon forget. The Subcommittee's caustic rebukes should be a constant reminder to departments that, without its permission, Congress does not countenance arbitrary withholding of information.

The internal relationships of the information offices to their superiors and others within the departments are treated at some length. Particular attention is paid to the growing influence of the departmental information offices in controlling or supervising the work of the bureau information offices.

The central theme of this study is that Government information practices are subjected to important controls from without, limiting the degree to which the departments can manipulate public opinion. And these controls are exercised by the Congress, which is traditionally hostile to bureaucratic self-pleading, and by the alertness of the mass media in opposing restrictions on the flow of information from Government.

Microfilm \$4.85; Xerox \$17.10. 378 pages.

PSYCHOL'OGY

PSYCHOLOGY, GENERAL

TEMPORAL CHARACTERISTICS OF DYNAMIC CONTOUR PERCEPTION

(L. C. Card No. Mic 59-5152)

Leo John Baranski, Ph.D. Princeton University, 1959

This study is presented in two parts, the first being an experimental study of the temporal characteristics of

contour formation of a moving stimulus under several conditions of illumination and three stimulus sizes. Contour perception here is taken to mean the formation and subsequent maintenance of sharp edges during the entire movement phase of a small (a few degrees in visual angle) stimulus. Such contour is usually not maintained at speeds exceeding about 15 o/sec.; however, if the stimulus is first presented in a fixed position, contour may be maintained at speeds up to 30 o/sec. This study then investigated the relation between the velocity (V) of the moving stimulus and the duration of the exposure (T) of the

stationary phase before movement under several conditions of illumination and stimulus size.

The criterion of maintaining contour was that the stimulus should be seen as sharp and clear during the entire extent of movement. Thus, an interesting feature of the data is that dynamic contour is never perceived under any condition, even at the slowest speed, unless there is at least a very short duration of T. It was found that, within the limits of this experiment, when contour formation is hampered by the stimulus speed, an increase in T facilitates contour formation of the subsequent moving phase. An increase in illumination level facilitates the perception of dynamic contour at speeds above 10 - 15 o/sec. The ease with which dynamic contour can be seen at slow speeds. and the fact that there seems to be a minimum excitation level to be overcome, combine to eliminate differences between the various conditions at speeds under 10 - 15 o/sec. For similar reasons, an increase of stimulus size facilitates dynamic contour formation particularly at speeds above 10 - 15 o/sec. and at low illumination levels. A change in the contrast ratio (between screen background and stimulus brightness) has no consistent effect upon dynamic contour formation.

In a second part of this study is forwarded the hypothesis that the nervous system involves a central quantum field structuring process which is quantal in nature. This proposed theory of sensory processes is based upon the quantum field theory of physics and, while of necessity many ramifications are omitted, a brief background of both quantal theory in psychology and quantum field theory is given. A new position of the quantum field and particle concepts of physics is presented. It is postulated that the basic substratum of the universe is a structured field whose intrinsic properties and formative tendencies are responsible for all processes and structural organizations. Reasons are given for the belief that a comprehensive and adequate explanation of sensory processes, indeed all psychological phenomena, must be based upon a central structuring process and that the underlying parameter must be one (here held to be the quantum field structure) which can be empirically discovered.

This view leads to an expectation of step-wise functions in sensory discrimination. Individual plots of the data gathered in this study, although not at all conclusive, are used as an indication that dynamic contour discrimination is far from being continuous.

Microfilm \$2.50; Xerox \$5.80. 120 pages.

SOME FUNCTIONAL THEORIES OF RELIGION AND THEIR PHILOSOPHICAL BASES: AN ESSAY IN THE INTEGRATION OF PHILOSOPHY, RELIGION AND SOCIAL SCIENCE.

(L. C. Card No. Mic 59-6296)

Robert Charles Browne, Ph.D. Syracuse University, 1959

Please see abstract on page 4408.
Microfilm \$2.50; Xerox \$7.60. 163 pages.

CONFORMITY, DEVIATION AND LEADERSHIP AS A FUNCTION OF FEEDBACK IN GROUPS.

(L. C. Card No. Mic 60-1464)

Austin Whitcomb Flint, Ph.D. Louisiana State University, 1960

Supervisor: Professor Bernard M. Bass

Twenty-six groups of five subjects each were studied to determine the effects of feedback on subsequent group behavior. Feedback was given while the group problem solving was still in process. Each group was given ten problems, each to be solved individually, before and after a discussion period. The use of an analog computer permitted the experimenter to give feedback on the first solution before the discussion began on each problem. In one-half of the groups each member was told the extent of his deviation from other members as well as how accurate his solution was. The remaining groups were given the same problems but no feedback was administered. The criterion measures consisted of final accuracy, final agreement between members, stability from the first solution to the second, amount of time each member talked during discussion, attraction to the group and esteem of other members. It was found that members of groups which had received feedback were more accurate in their final solution, and were slightly more attracted to the group. Deviant members with inaccurate solutions were more reluctant to accept the majority opinion unless they had been informed of their position. Group members who were more accurate than other members were much more likely to attempt leadership if they had knowledge of their accuracy than if they did not.

Microfilm \$2.50; Xerox \$3.00. 54 pages.

OPEN AND CLOSED BELIEF SYSTEMS
AS CORRELATES OF THE ACCEPTANCE OF
NEW MUSIC AND ITS COMPOSERS

(L. C. Card No. Mic 59-5603)

Bernard Mikol, Ph.D. Michigan State University, 1958

Three interrelated experiments were undertaken within the conceptual framework of Rokeach on open and closed belief systems. The purpose of Experiment I was to investigate the relationship between open and closed belief systems and response to new music. From the theoretical model it was hypothesized that those with closed belief systems would be less accepting of new music than those with open belief systems. It was further hypothesized that those with closed belief systems would be less accepting of the composer than those with open belief systems.

One hundred and thirty-three sophomore students who had taken the Dogmatism Scale, the measure of open and closed belief systems, were exposed to two unfamiliar samples of music, one conventional as exemplified by Brahms, and the other extremely modern as exemplified by Schonberg. The results support the hypotheses that those with closed belief systems are less accepting of the new music and of the composer than those with open belief

systems. No significant differences were found between these groups in age, intelligence as measured by the ACE, acceptance of conventional music, or knowledge about music as measured by a composer-composition matching test.

Experiment II was designed to re-test the previous hypotheses and to test two additional ones: given successive exposures to new music, those with relatively open belief systems would show a significantly larger gain in acceptance of the new music than those with closed belief systems. A parallel hypothesis was made concerning composer acceptance.

Brahms and Saint-Saens were used as samples of conventional music and Schonberg and Bartok as samples of new music. The results supported the hypotheses as they relate to Schonberg and his music but not to Bartok or his music. Schonberg's music was interpreted as being more

extremely new than Bartok's music.

In Experiment III, the relationship between affect and cognition was explored. A cognitive task requiring both the overcoming and the integration of sets was used, and hypotheses were formulated that individuals most negative in their feelings about a new musical system would be slower in solving the problem and would find greater difficulty in integrating the sets into a new belief system than individuals extremely positive in their feelings about new music.

On the basis of their responses to a musical situation modeled after Experiment II, two groups of subjects were chosen to perform individually in the cognitive task. The groups were matched on acceptance of conventional music but as different as possible in the acceptance of new music. Though no significant differences were found, they were in the direction predicted by the hypotheses, suggesting that a low order relationship may exist between acceptance of new music and performance in a cognitive task.

Failure to confirm the hypotheses was explained in terms of the differences in the nature of the two tasks, i.e., reacting to music vs. solving a problem, and in terms of statistical considerations given the results of the previous study. An alternative hypothesis positing a parallelism between the range of affect and the range of cognitive functioning was suggested. Affective narrowing is hypothesized to co-occur with cognitive narrowing and conversely, affective openness to co-occur with cognitive openness.

Microfilm \$2.50; Xerox \$6.40. 132 pages.

PERSONALITY CORRELATES OF CREATIVITY

(L. C. Card No. Mic 60-1392)

Jeanne McEachern Rutherford, Ph.D. Vanderbilt University, 1960

Supervisor: Professor O. J. Harvey

The present study was concerned with identifying and measuring a stable and generalized manner of approaching situations that is characteristic of creative persons. Three basic personality factors were hypothesized as underlying the creative process: the ability to differentiate and reintegrate parts of a whole, an openness of system, and self-strength. The behavior of creative persons

was defined in terms of the ability to create new and original designs, objects, and ideas, and to prefer these designs, objects, and ideas commonly judged most aesthetic and beautiful.

The three variables characterizing the underlying personality factors and the variable of creativity were each operationally defined by a series of test situations. Performance measures obtained from the tasks defining each variable were intercorrelated, and in nearly every instance significant positive relationships were obtained. These positive correlations gave evidence that the tests chosen to define each variable were in each instance measuring some common element. Therefore, scores from the tests defining each of the several variables were combined to form a total score which became the measure of ability demonstrated on that variable.

Intercorrelations computed between the three variables characterizing the basic personality factors yielded nonsignificant results, indicating that the several variables were essentially independent. The correlations obtained between the variable characterizing creativity and each of the independent personality variables, while not significant, in each instance approached significance, and were higher than the correlation coefficients obtained between the personality variables. The relationships between combinations of the several personality variables and the variable of creativity were described and evaluated by means of multiple correlation and chi-square tests.

From these results, it is suggested that the individual who prefers and is able to produce the more aesthetic and original design, poem, or idea is that individual whose approach to a new situation is characterized by:

- (1) The ability to differentiate various aspects of the situation and to integrate these aspects into a meaningful
- (2) An openness of self-system so that there is the ability to take new ideas into the system of subject-object relationships and to change old relationships when change is called for.
- (3) Self-strength, so that having adequately differentiated various aspects of a new situation, these aspects may be realistically perceived and reacted to as differentially involving to self.

The results support the hypothesis that there are independent, stable, and definable variables which characterize a manner of seeing, organizing, and reacting to stimuli, which in this study has been defined as the creative process.

Several aspects of the general problem of creativity are suggested for future research.

Microfilm \$2.50; Xerox \$5.80. 117 pages.

THE APPRAISAL OF THE BEHAVIOR OF THIRTY SEVERELY MENTALLY RETARDED CHILDREN, THEIR PARENTS, AND SIBLINGS.

(L. C. Card No. Mic 60-385)

Frances Aliene Scott, Ph.D. Syracuse University, 1959

Please see abstract on page 4312. Microfilm \$3.75; Xerox \$13.30. 291 pages. AN EXAMINATION OF THE USE OF LINEAR AND NON-LINEAR DISCRIMINANT FUNCTIONS IN THE CLASSIFICATION OF COLLEGE STUDENTS INTO ACADEMIC GROUPS

(L. C. Card No. Mic 59-1207)

Walter Richard Stellwagen, Ph.D. Syracuse University, 1958

In psychology and education previous statistical approaches to the problem of classifying people into groups have utilized only linear functions of the measurements involved. Counselors and clinicians, on the other hand, seem to successfully utilize non-linear information present in the measurements.

A procedure was developed by the author for utilizing polynomial functions of multiple measurements as an aid in the classification of people into defined groups. The procedure is a generalization of the linear multiple discriminant functions of Bryan and Rao and includes those functions as a special case.

To demonstrate the use and the computational feasibility of the new procedure and to contrast its use with the available Bryan-Rao functions, both the new procedure and the Bryan-Rao functions were used to classify students into defined groups on the basis of psychological tests administered when the students began college.

Three groups of students at Syracuse University were used in this study. They were students who, in their junior year, had chosen their major field of study in the College of Applied Science, the College of Business Administration, or in specified departments of the College of Liberal Arts. The measurements used were the Kuder Preference Record, Form B, the American Council on Education Psychological Examination, 1952 Edition, and the Cooperative Reading Test, C2, Form T.

The experimental hypothesis was that the use of nonlinear functions of test scores would lead to fewer students being misclassified than would the use of linear functions.

A double cross-validation design was used to examine this hypothesis. The groups were randomly divided in half, yielding two subsamples of three groups each. Linear and quadratic discriminant functions and associated classification procedures were developed on each subsample. These same procedures were then applied to the other subsample to classify its members. The number of students misclassified by each procedure was noted.

The data did not support the experimental hypothesis. The two subsamples were denoted as I and II. The proportion of misclassifications occurring when linear functions were used was .26 for Subsample I and .27 for Subsample II. When quadratic functions were used the proportions were .30 for Subsample I and .27 for Subsample II.

The computational feasibility of non-linear discriminant functions was demonstrated. However, for the data in this study the use of non-linear functions instead of linear functions seems to be unwarranted. Possible reasons for this were discussed and implications for future research presented.

Microfilm \$2.50; Xerox \$6.60. 138 pages.

THE DEVELOPMENT AND PRELIMINARY EVALUATION OF A CHECK LIST OF HOURLY AND NON-EXEMPT JOB ACTIVITIES

(L. C. Card No. Mic 59-6273)

Walter D. Storey, Ph.D. Purdue University, 1958

Major Professor: C. H. Lawshe

The purpose of this applied research was to develop a check list of job elements which would serve as the basis for the statistical identification of meaningful job families and for the development of synthetic validities of psychological tests which are used to assist the selection, placement, transfer, and promotion of industrial personnel.

A check list of activity elements and a job analysis manual for describing a variety of both hourly and non-exempt type jobs were developed for one of the nation's producers of aircraft gas turbines. An important part of the Manual, the sample job tasks which are used as examples of the activity elements, was developed through the use of statistical tests of significance involving computation of Chi Squares from frequency distributions of judgments by industrial personnel made in matching the examples with the activity elements. The examples were collected by means of the observation-interview type job analysis of jobs in process; foreman, supervisors, managers, and salaried job incumbents being the interviewees.

With the aid of the Manual, the Check List was applied to a sample of jobs which represented a wide variety of duties and which included eleven hourly rated jobs and nine non-exempt type jobs. All but two of the jobs were analyzed by four individuals whose duties involve the use of job descriptions. Two jobs were each analyzed by three similar individuals.

The obtained four-to-four coefficients for the proportion of overlap for checking the presence of the activity elements in a job ranged from .77 to .94 for the hourly rated jobs and ranged from .81 to .92 for the non-exempt type jobs. Each of these coefficients may be interpreted as a fair description of the percentage of activity elements which are checked by each of all the job experts who analyzed a given job under the conditions in this pilot study. The extent that a job is standardized or well defined, as opposed to the extent that a job is mechanistic, appears to be the most important factor with respect to the percentages of overlap obtained in this study.

When a combined Check List was formed for each job by pooling all activity elements which were checked by at least two of the job experts, the four-to-four reliability of ratings for the pooled elements, as estimated by the Intraclass Correlation, ranged from -.57 to .66 for the hourly rated jobs and from -.07 to .69 for the non-exempt type jobs. When elements were pooled which were checked by at least three of the job experts, the four-to-four reliability of the ratings ranged from -.48 to .29 for the hourly rated jobs and from -.32 to .63 for the non-exempt type jobs. With one exception, the reliability of the ratings was lowest for each job when only activity elements were pooled which were checked by at least three of the job experts.

The following conclusions were submitted:

1. A job description check list has been developed and

applied with satisfactory reliability to a sample of 20 jobs which vary considerably in terms of job content.

- 2. The job description check list which was developed is appropriate for reliable application to jobs on a large scale.
- The job experts can not acceptably rate the importance of the activity elements which are present in a job in accordance with currently prescribed procedures.

Microfilm \$3.50; Xerox \$12.15. 269 pages.

PSYCHOLOGY, CLINICAL

AN EXPERIMENTAL INVESTIGATION OF THE CONTRIBUTION OF OBJECTIVE MEDIATORS TO TRANSFER IN PAIRED-ASSOCIATE LEARNING

(L. C. Card No. Mic 60-1395)

Allan Gene Barclay, Ph.D. Washington University, 1960

Chairman: James M. Vanderplas

The purpose of the study was twofold 1) to provide an objective mediator in the verbal mediate association paradigm; and 2) to develop a sensitive evaluation of the relative contribution of mediation to transfer in pairedassociate learning. Ss learned three paired-associate lists composed of random shapes as stimuli and nonsense syllables as responses. First-list random shapes served as observable mediators in the second-list learning of experimental groups and were presented contiguously with the response members of the second list, contingent upon correct response by S. An observable mediator was defined as a stimulus, a random shape, interposed physically in the mediation process. The frequency of occurrence of this observable mediator was dependent upon specified levels of probability of occurrence existing within the experimental group under consideration. Identical learning tasks, with the exception of the observable mediator for the experimental groups, were used for the experimental and control groups. The performance of the control group offered a reference level of transfer against which to compare the additional effect provided by the observable mediator.

It was hypothesized that the provision for an observable mediating stimulus in the verbal mediate association paradigm would allow for development of mediation since the observable mediator would be more readily available to the S than in mediation studies where the mediating stimuli are inferred. It was also hypothesized that manipulation of the frequency of occurrence of this observable mediating stimulus would produce differential effects among the experimental groups.

Evidence was adduced, from a review of experimental literature dealing with mediation, that an interpretation of the phenomena of mediation by recourse to the inferred action of mediating common stimuli might more parsi-

moniously be ascribed to the effects of transfer, and that when general and specific transfer effects are controlled the residual increment in facilitation of learning attributable to mediation is insignificant.

Statistical analysis of the data of the study indicated that no significant differences existed among the experimental groups as a result of manipulating the frequency of occurrences of the observable mediator. A significant difference was found, however, between the combined experimental groups and the control group. But in the absence of significant differences among the experimental groups, the significant difference between the combined experimental groups and the control group was not felt to be convincing evidence for the presence of a mediation effect per se. The occurrence of such a difference might perhaps be better explained on the basis of simpler principles already available in learning theory. It was suggested that the observed significant difference between the combined experimental groups and the control group is perhaps accountable on the basis of general transfer effects together with an effect of enhancement of positive transfer for all the experimental groups as a result of altered stimulus conditions for the experimental groups.

It is concluded, within the limitations of the present experimental method, that mediational effects seem indistinguishable from those of transfer and that even the inclusion of a sensitive method for allowing mediation to develop did not produce convincing evidence for mediation effects per se.

Microfilm \$2.50; Xerox \$4.60. 89 pages.

THE INFLUENCE OF DEPENDENCY-ANXIETY
ON THE EFFECTIVENESS OF SOCIAL REINFORCERS

(L. C. Card No. Mic 60-1354)

Robert Bennett Cairns, Ph.D. Stanford University, 1960

The purpose of this study was to test the hypotheses that low dependency-anxious subjects would strive for social reinforcers by learning simple tasks eliciting adult approval, whereas, subjects displaying high dependency-anxiety would show decrements in learning performance under conditions of social reward.

Seventy-three adolescent boys who were being detained in a Juvenile Hall served as subjects. The subjects were subdivided into four experimental groups and one control group. Assignment to the experimental groups was based on ratings of the boys' dependency-anxiety they showed in fantasy. On this basis the following four groups were selected: High-High (HH), subjects judged to be high dependency-anxious on both the behavior rating scale and the incomplete stories; Low-Low (LL), subjects who appeared to be low dependency-anxious on both measures; High-Low (HL), subjects judged to be high dependencyanxious with respect to overt behavior but low dependencyanxious on the fantasy measure; Low-High (LH), subjects rated low dependency-anxious on behavior scale but high dependency-anxious with respect to the incomplete stories. A fifth group of subjects constituted a control

To test the general hypothesis that social rewards

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would have differential effects for high and low dependencyanxious individuals, the subjects learned three pairedassociate lists and participated in a series of verbal conditioning interviews in which confiding responses (family reference statements) were rewarded. The control group received no social reinforcement on the learning tasks. In addition, the subjects were administered a near unsoluble task designed to measure the extent of dependency inhibition.

The main findings were:

1. The low dependency-anxious subjects increased their rate of confiding responses and learned paired-associate items more rapidly when rewarded with verbal approval. In contrast, the high dependency-anxious subjects not only failed to condition, but under the cumulative effects of rewards they showed a significant decrease in the number of confiding responses emitted. In the paired-associate learning the high dependency-anxious subjects, after an initial improvement, showed a decrement in learning in response to approval rewards.

2. On the puzzle task, the low dependency-anxious subjects readily sought the experimenter's help; the high dependency-anxious subjects, on the other hand, strongly inhibited and resisted any help-seeking behavior.

These main findings pertain to only the consistently high dependency-anxious (HH) and low dependency-anxious (LL) groups. The performance of the HL and LH groups on the tasks was included in the presentation of the experimental results.

The implications of these findings for the social training, and for the treatment of the dependency-anxious person were discussed.

Microfilm \$2.50; Xerox \$6.40. 133 pages.

THE EFFECT OF VERBAL AND NONVERBAL REINFORCEMENT ON THE VERBAL BEHAVIOR OF GERIATRIC SUBJECTS

(L. C. Card No. Mic 60-1407)

Patrick John Dignam, Ph.D. The Florida State University, 1960

This study was undertaken in order to answer 3 questions: (a) Can the verbal behavior of a geriatric subject be modified by means of operant conditioning? (b) Are the contingent stimuli; "mmm-hmm," a nod and a smile reinforcers when dealing with this population? (c) What are the absolute and relative efficiencies of these 3 responses when used singly and in various combinations as reinforcers?

The results of this experiment have indicated that the verbal behavior of geriatric subjects can be modified by operant conditioning. These results were obtained by utilizing basic operant conditioning techniques and "typical" reinforcers.

Five responses proved to be reinforcers: (a) "mmm-hmm" (b) nod (c) "mmm-hmm"-smile (d) "mmm-hmm"-nod (e) "mmm-hmm"-nod-smile. The contingent stimuli, a smile and nod-smile were not reinforcers.

The analyses of the data also indicated that auditory stimulation, in the form of the single, verbal reinforcer, "mmm-hmm," was as efficient as any other form of reinforcement employed in this study.

The exhibition of "paranoid tendencies" and "rigidity" by geriatric subjects were discussed. The possible contributions of the experimenter, the subjects and the experimental design to the experimental error were advanced. The implications of the results of this study, in terms of the rehabilitation of geriatric patients, were also briefly considered.

In addition to the main study, a supplementary study was performed. This study concerned the interpretation of three responses by geriatric subjects. The three responses were; "mmm-hmm," a nod and a smile, i.e., the responses employed in the main study. The results of this supplementary study indicated that geriatric subjects hold divergent views concerning the connotations of these responses. These data thus supported the contention that "mmm-hmm," a nod and a smile cannot be considered as positive responses on an a priori basis (at least when dealing with geriatric subjects).

Microfilm \$2.50; Xerox \$3.00. 43 pages.

THE EFFECTS OF INTRA-GROUP AND INTER-GROUP COMPETITIVE CONDITIONS ON THE PERFORMANCE AND LEVEL OF ASPIRATION OF MALE PARANOID SCHIZOPHRENICS

(L. C. Card No. Mic 60-1104)

Chester W. Feuerstein, Ph.D. New York University, 1959

While much has been written and theorized about the effects of competition on human functioning, relatively little experimental research has been carried out in this area in proportion to its significance. Some theorists maintain that competition is frequently a major factor in breaking down an individual's psychological functioning. Still others postulate that competition acts as a dynamogenic factor for the productivity and creativity of the individual. There is much difference of opinion on the nature and extent of the effects produced by competition. Few valid conclusions can be drawn, if any, from the few, divergent, experimental studies conducted so far.

There have been no experimental investigations dealing directly with the effects of competitive conditions on the psychological functioning of psychotics. Since numerous psychologists and psychiatrists have suggested that inability to stand up to intense, competitive conditions is very often a major characteristic of schizophrenia, the present study was designed to throw some light on the effects of two specific types of competitive conditions, intra- and inter-group competition, on the performance and the level of aspiration of one sub-group of schizophrenics, male paranoid schizophrenics.

The 108 patients used in the experiment were assigned randomly to three experimental conditions, 36 subjects to each condition. All experimental procedures were carried out with sub-groups of six patients. The subjects were administered two equivalent sets of four different but brief and simple types of tests at one sitting (before and after the introduction of the competition variable). The four tests employed were Letter-Cancellation, Word-Finding, Arithmetic, and Hole-Punching.

The subjects in each of the three experimental conditions received differential instructions prior to the second

trial testing (instructions for all groups were the same on the first trial) and different standard comments during the second testing session itself, appropriate to the type of competition condition. At the conclusion of each set of tests, the subjects were asked to write numerical percentage estimates of their past performance (Guessed Score) and of what they thought they would get on a future testing (Aspiration Score). Finally, the subjects were requested to check which of the two sets of tests they had felt to have been "hardest."

The results were treated by analysis of variance and by t tests where indicated. The frequency of choices within each group as to which set of tests was "hardest" were examined by the Chi Square test applied to the contingency of choice and condition.

The results indicated subjects in the intra-group competition condition achieved lower scores on the second (competitive) trial than on the first (non-competitive) trial on all tests. There was also a significant drop in mean score from the first to the second trial in the inter-group competition condition, but the magnitude of the decrease in scores was significantly greater in the intra-group condition. No significant difference in mean score occurred between the first and second trials in the non-competitive condition.

It was also found that both competitive conditions produced a significant lowering of Guessed Scores and Aspiration Scores, while the non-competitive group actually tended to improve their scores, on the second trial. There was no significant difference in the size of the mean decrease in Aspiration Score between the intra-group and inter-group competitive conditions. The group which was most pervasively, negatively affected by the competition variable (intra-group competitive) was the only group that significantly judged one set of tests as being "hardest" and that was the second test.

The over-all results indicate that certain competitive situations have adverse effects on male paranoid schizophrenic patients and possibly on other similar psychiatric patient groups as well. An overall appraisal of hospital routines and programs for these patients is suggested in order to modify those competitive situations which the present results suggest may be deleterious. However, any broad application of the present findings requires further experimental research with other populations and with other competitive conditions.

Microfilm \$2.50; Xerox \$8.60. 188 pages.

THE INTERACTION OF PATIENTS' INTELLIGENCE AND OTHER FACTORS WITH CLINICIANS' SKILL IN THE DIAGNOSTIC USE OF HUMAN FIGURE DRAWINGS

(L. C. Card No. Mic 60-1408)

Miles W. Hardy, Ph.D. The Florida State University, 1960

An investigation of the influence of factors such as intelligence and type of drawing on clinicians' ability to make differential diagnosis from drawings was carried out using psychotic and neurotic subjects from a neuropsychiatric setting. Reviews of the literature reveal numerous studies in which writers have sought to isolate objective indices on which to base differential diagnosis. Other investigators have utilized the more popular global approach. None, however, have examined the relationships between intelligence and differential diagnosis.

This research, using the global approach, investigated relationships existing between emotional maladjustment, as it is classified into diagnosis, and figure drawings. Broad characteristics of the subject, type of drawing, and the clinical experience of the interpreter were also tested.

The following problems were investigated:

- 1. Can the drawings of psychotics and neurotics be significantly distinguished from "normal" drawings?
- 2. Is level of intelligence related to assignment of diagnosis?
 - a. Which levels of intelligence and diagnosis are related?
 - b. Is the diagnosis by judges of different experience influenced by the intelligence of the drawer?
- 3. Does the level of experience affect ability to make diagnosis?
 - a. Is diagnostic accuracy increased by use of a battery of drawings?
 - b. Is there a relationship between the type of drawing and level of clinical experience?

Procedure

Ninety male psychotic, neurotic, and "normal" subjects meeting a strict criterion were matched for high, average and low intelligence and requested to produce three types of human figure drawings--Same Sex, Opposite Sex and Self. Fifteen judges representing three levels of figure drawing experience sorted the drawings separately and as a battery using the global approach.

A Chi-square statistical treatment of the data was made with probability coefficients adjusted to give only the probability of correct responses exceeding chance.

Results

All judging groups shows a high reliability. No significant difference was found between the sorting reliability of PhD's, trainees and nurses.

Although all judges showed a significant ability to identify drawings, it was their correct identification of the psychotic drawings that significantly contributed to differentiation.

Diagnostic errors were less prevalent when the diagnostic range was increased. Thus fewer errors occurred from confusion of "normal" with psychotic drawings.

Intelligence was not a significant factor in sorting when correct responses were pooled. However, relationships were shown between specific diagnostic categories and intellectual levels. PhD's were able to make significant identifications (.05 level) when drawings were produced by intellectually average or low psychotics and intellectually high "normal" subjects. Trainees significantly identified drawings by intellectually average psychotics.

In each case the correct responses of judges to figure drawings produced by intellectually low "normals" failed

to meet chance frequency. Judges showed a clear tendency to associate artistic excellence and intelligence with degree of pathology. The "normal" subject of low intelligence was particularly vulnerable to misdiagnosis with his chances of a correct, "normal" diagnosis far below chance.

A linear trend between judging experience and correct identification was shown.

None of the three types of drawings contributed significantly to judges' combined skill in making identifications. PhD's, however, used Same Sex and Self drawings to a significant degree. Opposite Sex drawings appeared to possess characteristics that confuse diagnosis.

Use of a drawing battery reduced the validity of figure

drawings as a diagnostic tool.

Results tend to negate the use of figure drawings as a general tool for assaying adjustment level, but support their value in the hands of an experienced clinician when the subject is of average intelligence.

Microfilm \$2.50; Xerox \$4.20. 80 pages.

DEVELOPMENTAL DIFFERENCES BETWEEN SUCCESSFUL AND UNSUCCESSFUL INTELLECTUALIZERS

(L. C. Card No. Mic 60-1318)

Francis Monroe Ledyard, Ph.D. University of Houston, 1960

A relationship between differences in adult personalities and differences in developmental experiences has been recognized at least since the time of Freud. This conception has been the basis for many investigations. Recently the emphasis of research in the area of developmental experiences has been on parental attitudes.

The intent of the present study was to investigate background and developmental differences between a psychiatric group and a normal group, using a particular predominant defense mechanism, intellectualization, as

an additional control factor.

Two groups of intellectualizers were chosen for this study on the basis of Rorschach protocols. Schafer's criteria was the basis for determining the primary defense. "Unsuccessful" defenders, or the psychiatric group, were subjects who were or who had been hospitalized for psychiatric treatment. The "successful" defenders, the adapted group, was composed of intellectualizers who had not needed hospital treatment for emotional difficulties. There were twenty-four subjects in each group, and they were matched on socioeconomic status.

The predictor instruments used in this study were a Developmental questionnaire based on the Weiss-Selzer interview schedule, the Parental Attitudes Research Instrument of Schaefer and Bell, and Kelly's Role Constructs

Repertory test.

The results indicated that the adapted group consistently has stronger identification with all individuals and groups than the neuropsychiatric group. This is particularly true of identification with the father, same sex roles, and total identification with all roles. The NP patients' homes were more authoritarian, and their mothers used martyrdom as a means of control more than the mothers of the adapted group. There is a tendency for the homes

of the adapted group to be more democratic than those of the neuropsychiatric group. Harsh, psychological punishment was used more often by the parents of the psychiatric patients. The NP group were more rejected and extrinsically valued than the adapted group. The adapted group, for their part, received more independence training than the NP group. There was more conflict in the parental homes of the NP subjects than in the homes of the adapted group. There was also more interpersonal conflict in the lives of the NP group outside the parental home. In all the findings where the family is concerned, there is at least a tendency for the mother to be the dominant, malignant factor.

A number of the results were opposite to the expected direction. The adapted intellectualizers demonstrate more dependency attitudes than the NP intellectualizers. They also used more extrinsic values in their choice of Rep test constructs to characterize the roles of significant individuals in their lives. The adapted group apparently has a more rigid conceptual system than the NP group.

The finding of authoritarianism and rejection, particularly maternal authoritarianism and rejection, is similar to the pattern found by Rodnick and Garmezy and others in studies of poor premorbid subjects. There are, however, at least two differences between the poor premorbid subjects used in those studies and the psychiatric subjects used in the present study: No pattern of overprotectiveness was elicited in the psychiatric intellectualizers, and their rate of recovery was comparatively good.

It was suggested that this difference might have been due to successful desatellizing, using Ausubel's terms. It was further suggested, in view of the above, that, just as infancy is the critical period for establishing intrinsic self-esteem, preadolescence and adolescence may be the period in which an adequate, relatively permanent defense system is built up.

Suggestions concerning further investigation of the defense systems of intellectualizers were made.

Microfilm \$2.90; Xerox \$10.15. 224 pages.

A COMPARATIVE STUDY OF THE EXPERIENTIAL CHARACTERISTICS OF A GROUP OF PEPTIC ULCER AND NON-ULCER SUBJECTS

(L. C. Card No. Mic 59-6284)

Frank George Mullen, Jr., Ph.D. The University of Tennessee, 1959

Major Professor: G. R. Pascal

The purpose of this study was to develop hypotheses concerning variables related to the formation of peptic ulcer in man. The subjects used in this research were nine peptic ulcer patients hospitalized at the Atlanta, Georgia, Veterans Administration Hospital and nine controls matched on age, intelligence, education, occupation, sex and marital status. The controls did not have peptic ulcer. Each subject was given a standard psychological interview which was intensive in nature.

From the intensive psychological interviews, case histories for the eighteen subjects were prepared. Each case history was rated by two raters on a total of sixty-five

behavioral variables. Forty-nine of these variables were gathered from the Pascal-Jenkins Behavioral Scales and pertained to the kind of stimuli encountered by the subjects during the first ten years of their life. The remaining sixteen variables composed the U-T Deprivation Scale which measures the amount of need gratification a subject is receiving from his present environment. Each variable was analyzed by non-parametric statistics to determine if the peptic ulcer group and the control group were significantly different on any variable.

Analysis of the cross-sectional variables of the U-T Deprivation Scale yielded a significant difference between groups. The ulcer group was receiving less gratification from the current environment than the control group. An item analysis of this Scale revealed that only two items, Fear and Residence, differentiated the experimental and control group. Analysis of the Pascal-Jenkins Behavioral Scales revealed that the ulcer subjects received more psychological deprivation during the first ten years of life than did the controls. Twelve of the forty-nine variables relating to the stimuli encountered during the first decade were significant at the .10 level of confidence or better (six were .05 or better). The greatest amount of deprivation for the experimental subjects was experienced from the Father, mostly in the form of harsh and frequent punishment, severe restraints and lack of affection. The ulcer subjects received more deprivation during their first ten years of life from the Father than any other adult figure. An attempt to relate psychological deprivation to the etiology of peptic ulcer was presented. Hypotheses from the data were also presented. The need for replication and further investigation of behavioral variables was mentioned. Microfilm \$2.50; Xerox \$4.00. 74 pages.

PERCEPTUAL DEFENSE AND SOMATIZATION: A COMPARISON OF THE PERCEPTUAL THRESHOLDS OF OBESE AND PEPTIC ULCER PATIENTS.

(L. C. Card No. Mic 60-1314)

Channing Haskell Orbach, Ph.D. University of Southern California, 1960

Chairman: Professor Seward

Psychoanalytic theory maintains that obese and peptic ulcer patients are both fixated at an oral level of psychosexual development. Psychoanalysis further maintains that the repressed impulses associated with such fixation are constantly striving for expression. Whereas the obese individual gives in to his oral impulse by eating, the peptic ulcer individual develops a counteractive defense. This study was designed to tap both the impulse striving and the defensive aspect by measuring, on two different levels of awareness, the perceptual responses of ulcer and obese subjects to the tachistoscopic presentation of an oral stimulus.

Hypotheses upon which the study was based were that (1) at a low level of awareness both obese and ulcer patients should be more vigilant with respect to an oral stimulus than patients who are not orally oriented, and (2) at a higher level of awareness ulcer patients should be

more defensive when confronted with an oral stimulus than either obese patients or nonoral controls.

Four Blacky pictures were flashed simultaneously on a screen at a speed well below the perceptual threshold of the subjects for a series of forty-eight trials. The same four pictures were used for each trial, but their relative positions differed from that of the previous trial. One of the four pictures was the Oral Eroticism cartoon. The other three were selected because they had approximately equal physical stimulus value. The subjects were instructed to select the picture that stood out the most on each flash. This series served as a baseline for evaluating subsequent responses.

In order to insure equal familiarity with all four pictures, and also to provide additional data on orality, the subjects were administered the Blacky test immediately following the first tachistoscopic series.

Tachistoscopic performance, repeated immediately following the Blacky test, was used to measure perceptual vigilance and the scores for the two series were compared. Higher scores on the second series than on the first for the obese and ulcer patients would support Hypothesis 1.

Perceptual defense was measured by introducing a third tachistoscopic series. On this series the speed of exposure was reduced to near threshold level and the subjects were asked to find the Oral Eroticism picture. Lower scores for the ulcer patients than for the obese or control patients would support Hypothesis 2.

A questionnaire was utilized to assess oral interests and attitudes. The subjects were 65 male patients of Veterans Administration medical facilities. The ulcer group consisted of 16 hospitalized patients and 9 outpatients. The obese group was made up of 3 hospitalized patients and 12 outpatients. The control group, 25 in number, were all hospitalized.

Results. All three groups scored lower on the second tachistoscopic series than on the first. The direction of change in scores was opposite to that predicted for perceptual vigilance. There were no significant differences among groups.

The literature has described a second type of ulcer patient, who, instead of developing a counteractive defense to oral dependency, is overtly passive and demanding. An attempt was made to delineate the two ulcer subtypes by sorting the Blacky test protocols on the basis of the inquiry items. No clear-cut distinction emerged from this analysis.

On the perceptual defense series both the ulcer and obese groups scored lower than the control group but not significantly so. The control group showed significantly more evidence of oral conflict on the Blacky test than either the ulcer group alone or the combined oral groups. However, the obese and ulcer groups each showed more evidence of oral interests and attitudes on the questionnaire.

Conclusions. The hypotheses relating to perceptual vigilance and defense were not supported. However, obese and ulcer patients were shown to be more typically oral in their interests and attitudes. It was speculated that oral character traits represent successful repression of oral conflict.

Microfilm \$2.50; Xerox \$6.00. 123 pages.

THE EFFECT OF EDUCATIONAL PHILOSOPHIES ON THE PERSONALITIES OF SOCIO-ECONOMICALLY DEPRIVED NEGRO CHILDREN

(L. C. Card No. Mic 59-6252)

Elliott Seymour Shapiro, Ph.D. New York University, 1959

This study is an attempt to determine the effect of two different philosophies of education, differing in their willingness to encourage criticism, on two equated sixthgrade groups of socio-economically deprived Negro children.

The four sub-problems covered the relationships that might exist between an educational philosophy and 1) intellectual achievement, 2) perception of adult authority, 3) perception of peers, and 4) perception and coping with frustrating situations.

The three hypotheses indicated the expectations that an educational philosophy has a definite effect 1) on educational and intellectual growth, 2) on the attitudes toward authority figures and peers, and 3) on the ability to deal with frustrating situations.

The study was felt to be significant in its implications for educational philosophy, juvenile delinquency, evaluation of Negro intellectual potential, and the psychotherapeutic possibilities of education. These implications governed the description of the literature that was related to this study.

The two groups were given a battery of intelligence, achievement, and projective tests at the beginning and at the end of the six month period of investigation. A case history was prepared for each pupil, and frequent observations of the two classes were reported.

The sub-problems governed the treatment of all data, with results being considered significant only if they attained the five per cent level of confidence.

The interpretation and discussion centered about the statistical results and the insights provided by the background inquiry and the observations of the groups. While the findings concerning the effect on intellectual growth did not achieve significance, the results tended to favor the children who had been encouraged to become critical, and it was thought that an extension of the investigatory period could lead to significant confidence levels. The projective tests resulted in somewhat contradictory outcomes in regard to adult authority relationships, but the observations indicated that one of the tests was insufficiently sensitive. The results were further influenced by the favorable consequences of the unexpected favoritism displayed by one teacher toward some of the girls. The implications of these favorable consequences were explored. The test for effect on peer relationships significantly favored the group that had not been encouraged to criticize, but the observations contradicted this finding. It was suggested that this test, too, was insufficiently sensitive. On the other hand, the children who were encouraged to become critical became significantly more capable in coping with frustrating situations, despite the favorable consequences of the favoritism displayed by the teacher in

The following implications of the test results, the observations, and the background inquiry were noted. Deprived Negro children would benefit from active adult intervention in their behalf. Encouragement of criticism

by children tends to lead to friction among teachers. Relatively few teachers can maintain their composure when criticism is actively encouraged. Teacher-training institutions should prepare teachers to encourage critical thinking.

In the summary in terms of the hypotheses, the third hypothesis concerning the ability to cope with frustrating situations was confirmed. The results were inconclusive for the others, but the results were such as to warrant further investigations.

Microfilm \$2.50; Xerox \$8.40. 183 pages.

A STUDY OF EARLY WARD SOCIALIZING BEHAVIOR AND INTER-PATIENT ATTITUDES IN RELATION TO IMPROVEMENT OF FEMALE MENTAL PATIENTS

(L. C. Card No. Mic 66-1092)

Grace Pennington Surber, Ph.D. New York University, 1959

The Problem

The purpose of this investigation was to evaluate ward socializing behavior and inter-patient attitudes of female patients during the first week following admission to a state hospital in relation to various indices of improvement.

It was hypothesized that:

- 1. A high degree of ward socializing behavior during the first week following admission will have a positive relationship to rate of improvement over a nine-week period of hospitalization.
- 2. There is a positive relationship between interpatient attitudes and rate of improvement.
- 3. Most rapid improvement will occur in those patients demonstrating positive inter-patient attitudes as well as a high degree of ward socializing behavior.

The population sampled consisted of forty-two female psychiatric patients between the ages of twenty and fifty-nine, who had been committed to a state hospital for the first time.

Procedure

Instruments were constructed for the purpose of evaluating two different aspects of patient behavior. (1) The Surber Ward Interaction Scale (SWIS) used to rate degree of ward socializing behavior. (2) A semi-structured interview used to rate inter-patient attitudes.

The SWIS rating scale used to test hypothesis I provided for five classifications of ward socializing behavior ranging from positive, out-going behavior toward other patients to isolate or negative behavior. Two co-observers rated each subject on the SWIS six times a day for a period of one week. The semi-structured interview used to test hypothesis II also provided for five rating categories ranging from most positive to most negative inter-patient attitudes. Experimental data for each subject consisted of thirty ward observations and interview information obtained during a fifteen-minute interview session.

Achievement of specific hospital privileges, with specified time limits, was used as the criteria of improvement. For statistical analysis, the population was divided into two groups. One group consisted of those subjects who had

achieved hospital privileges within the specified time limits, the other, those subjects who had not achieved hospital privileges. These groups were compared on the basis of ward socializing behavior ratings, inter-patient attitude ratings and a composite score for each patient derived from a combination of these scores.

Findings

Fisher's Exact Probability Test was used to determine whether or not there were significant differences in obtaining each of six hospital privileges between subjects demonstrating a high degree of ward socializing behavior and positive inter-patient attitudes and subjects possessing lesser degrees of these two aspects of behavior. Groups of patients who received scores of less than 3.0 (higher degrees of ward socializing behavior and positive interpatient attitudes) and greater than 3.0 (lesser degrees of ward socializing behavior and negative inter-patient attitudes) on the SWIS, the interview, and a composite of these scores, were compared on the basis of achievement, or failure to achieve, each of the criteria of improvement. Significant differences between the groups were found in all instances except one. The data supported hypotheses I and III. Hypothesis II was confirmed on five of the six criteria. Frequency polygons demonstrating the amount of overlap between the groups wo had, or had not, achieved hospital privileges, indicated that the differences between groups in most instances possessed practical as well as statistical significance.

Conclusions

Within the limits of the population sampled the findings lead to the following main conclusions:

- 1. Early ward socializing behavior is predictive of rate of improvement.
- 2. Inter-patient attitudes are also related to patient recovery but are not as adequate predictors of improvement as observable ward socializing behavior.
- 3. A high degree of early ward socializing behavior concomitant with positive inter-patient attitudes is the most stable predictor of improvement.

Microfilm \$2.50; Xerox \$6.60. 140 pages.

THE REINFORCING VALUE OF VERBALIZATION AS A FUNCTION OF ANXIETY

(L. C. Card No. Mic 60-1522)

John Martin Woodbury, Ph.D. Washington State University, 1960

The purpose of the present study was to investigate under different levels of anxiety the reinforcing properties of a verbalization for schizophrenic patients in the terms of hypotheses based on certain theoretical learning positions.

Previous research suggests that schizophrenic patients, in contrast to neurotic and non-psychiatric subjects, show little modification of behavior as a result of what normally are positive reinforcements. The first problem was to find a method by which verbalizations could be made reinforcing for schizophrenics and to relate this method to current theoretical positions. Some of these positions

stress the role of contiguity and drive in developing reinforcing strength. Others suggest that anxiety has drive properties and hence the strength of reinforcement should vary directly with the level of anxiety.

A competing point of view holds that so-called secondary reinforcement is not reinforcing in its own right but only a means to reinforcement. Similarly, the relationship between drive and strength of acquired reinforcement is also questioned.

The specific problem generated by the above controversy and investigated in this study is:

- (1) Whether verbalization of "Hmm" by E acquired positive reinforcement strength for schizophrenic patients when "Hmm" is contiguously associated with verbalization "Right";
- (2) Whether positive reinforcement strength of "Hmm" varies with different levels of anxiety.

Treatments based on different levels of threat, test difficulty, and failure information were administered to separate experimental groups of ten schizophrenic patients each, who had expressed a desire to leave the hospital but not to a control group of similar subjects. To provide different degrees of contiguity, "Hmm" was contiguously associated with "Right" for certain groups but not for other groups.

The experimental variables were distributed among the five groups as follows:

- Group I: High Anxiety: Implied failure on Difficult Test related to going home; "Hmm" contiguous with "Right."
- Group II: High Anxiety: Implied failure of Difficult
 Test related to going home; "Hmm" not
 contiguous with "Right."
- Group III: Low Anxiety: Implied success information of Easy Test related to going home; "Hmm" contiguous with "Right."
- Group IV: Low Anxiety: Failure information was not given, but subjects verbalized they were failing a difficult test not related to going home.

Control: No preliminary test.

On another occasion, all patients were administered a test requiring verbalization of sentences using one of the four pronouns, "I," "We," "He," or "They." E said "Hmm" following use of either "I" or "We" pronouns. Increment in use of "I" or "We" pronouns provided the measure of reinforcing strength of "Hmm" on which the five groups were compared.

Analysis of variance of increments of I-We responses yielded an F significant at the .001 level with most of the differences attributable to Group I.

The testing and analysis of various hypotheses indicate:

- (1) The lack of verbalization did not acquire negative reinforcing strength as a result of having been contrasted to "Right," nor did "Hmm" acquire positive reinforcement through stimulus generalization from "Right."
- (2) The above finding indicates that increments in Group I I-We responses were a function of the positive reinforcing properties of "Hmm."

- (3) Contiguous association of "Hmm" with "Right" was a necessary, but not sufficient, condition for acquisition of positive reinforcement properties of "Hmm."
- (4) The conditions of high anxiety were necessary, but not sufficient, conditions for acquisition of positive reinforcement properties by "Hmm."

 Microfilm \$2.50; Xerox \$4.20. 79 pages.

PSYCHOLOGY, EXPERIMENTAL

THERMAL THRESHOLD CHANGES AS A FUNCTION OF ADAPTATION TO DIFFERENT TEMPERATURES

(L. C. Card No. Mic 60-1406)

Barry Philip Childers, Ph.D. The Florida State University, 1960

Changes in absolute thresholds to thermal sensation in the skin with changes in adapting temperatures were studied. Separate threshold determinations were made for warm and cold at six adapting temperatures from 27° to 42° C.

Two college students, who were trained in making the required discriminations prior to the experiment, served as subjects. The test site was a 6 cm² area on the right volar forearm about two inches below the elbow.

The stimulator consisted of a thermode with a thin silver plate base, the temperature of which could be changed by switching between two streams of water entering the thermode from above. This apparatus allowed the presentation of rapid changes in temperature with negligible tactile stimulation accompanying these changes.

The subject was adapted to a given temperature until complete adaptation was reported or until a maximum period of 45 minutes had been reached. Threshold determinations were made immediately following this period, using the psychophysical method of constant stimuli. Five stimulus temperatures, at intervals of 0.05° C. from the adapting temperature, were repeated randomly at intervals of one minute and for durations of ten seconds or less. The subject's instructions were to press a key on the left arm of the chair whenever a change was noted in the thermal mode. This key was connected to a chronometer, so a measure of the subject's reaction time was obtained. Calculations of the thresholds were based on two categories of response, "change" or "no change".

The threshold changes at the different adapting temperatures were found to be as follows: Warm thresholds were highest at adapting temperatures of 33° and 36°, becoming lower on either side of this range to the extremes of 27° and 42° C. Cold thresholds were high at adapting temperatures of 27°, low at 30° and 33°, high again at 36°, and lower at 39° and 42° C.

All thresholds, both warm and cold, were found to be less than 0.25° C.

The warm thresholds were found to be generally lower than those for cold, and a consistent difference between subjects in the sizes of the thresholds was also noted. The results of this study were compared with those of previous investigations, and the points of agreement and disagreement were noted and discussed.

Microfilm \$2.50; Xerox \$3.00. 54 pages.

AN EXPERIMENTAL INVESTIGATION OF THE CONSTRUCT SELF-COGNITION

(L. C. Card No. Mic 60-1358)

David Freeman, Ph.D. Stanford University, 1960

This investigation is focused upon the relationship between certain self perceiving modes and perceptual activity describing a general perceptual orientation to experience. The design involves an initial measurement of certain perceptual qualities manifest in self perception and an attempt to predict perceptual outcomes in two experimental situations involving the use of a Pursuit Rotor and an original piece of apparatus called the Cognition Chamber. Some theoretical considerations concerning the self constitute a significant aspect of the study.

An instrument composed of eleven statements from the K scale of the MMPI and forty nine statements constructed by the investigator constitute the Cognition Inventory. The items are in the form of descriptive statements perceived as accurate or inaccurate descriptions of self. This instrument was administered to 1487 subjects. Use of the Brown Spearman formula yielded a reliability coefficient of .912 for the total sample. The shape of the distribution precluded description of the distribution as normal. Statements were selected and constructed so that they described facets of self that although not socially commendable were judged applicable to all persons in this culture. A number of expert judges were used to support this assumption.

Experimental groups were selected from both extremes and from the center of the distribution. Thus the Low Cognitor group were those subjects who perceived more items as self alien, High Cognitors perceived more items as self descriptive, and the Middle Cognitor group was composed of subjects between these extremes. Each group was composed of thirty subjects.

A proposed theory of modular perception was used to provide an explanation for these obtained differences. In terms of this theory the Low Cognitor group subjects were most prone to use distorting-defensive mechanisms to alter either self perception or data arising from experience. Subsumed within distorting mechanisms are the familiar defense mechanisms of denial, projection, repression, rationalization and suppression. Interest in this study was restricted to the perceptual consequences of these mechanisms rather than their processes. The High Cognitor group made the least use of these mechanisms in self perception and the Middle Cognitor group fell between the High and the Low Cognition groups. Furthermore, it was hypothesized that these mechanisms described not only certain qualities manifest in self perception but rather perceptual orientation to experience in general.

To test this and related hypotheses two experimental procedures were used. The first, the Pursuit Rotor, is too familiar to need further description. The relevant hypotheses stated that greater goal discrepancy scores would

be obtained by the Low and Middle Cognition subjects than for the High. The results did not support these predictions. In the second experiment involving the Cognition Chamber, a device five feet long, where photographs were presented under controlled lighting conditions ranging from complete darkness to high illumination, the hypotheses stated that the High subjects would obtain lower recognition thresholds for the presentations than subjects comprising the Middle and Low groups. The results strongly supported the hypotheses beyond the .001 level of significance. A fourth presentation in the form of a blue mirror was also used and the results again supported the hypotheses beyond the .001 level of significance.

Thus evidence is presented that self perceiving modes do describe a more general kind of perceptual activity. Furthermore, subjects who tended to distort their self descriptions in their responses to the items in the Cognition Inventory also experienced more difficulty in recognizing their mirror images under controlled lighting conditions. Microfilm \$2.50; Xerox \$8.60. 188 pages.

A COMPARISON OF SOMATIC RESPONSES IN A DISCRIMINATION AND A SIMPLE REACTION SITUATION

(L. C. Card No. Mic 60-822)

Frederick Paul Gault, Ph.D. Indiana University, 1959

This study is an experimental comparison of the somatic responses occurring in a simple reaction situation with those occurring in a discrimination reaction situation.

Two groups of students from undergraduate psychology courses served as subjects. The subjects, run one at a time, were seated in an air conditioned, sound-deadened, dark experimental room. All recording apparatus was in a separate room.

All subjects received twenty trials in one sitting. A trial consisted of the presentation of a one and one half second warning tone followed one and one half seconds later by the appearance of two lights on a panel in front of the subject. The simple reaction group was required to press a telegraph key each time the lights appeared. The discrimination group was required to press the key only when the two lights were in the same horizontal or vertical row on the panel. A key press was required of the discrimination group on fifty percent of the trials.

All of the data was dealt with in terms of the percentage of change from the pre-stimulus level which was determined immediately prior to each trial.

The principal results are:

The discrimination group showed a significantly greater degree of preparatory muscle activity during the warning signal. This effect was most pronounced during the later trials of the series, and in spite of the fact that the discrimination subjects made an overt key press on only fifty percent of the trials. It was not possible to differentially discern a key press and a non key press event on the basis of muscle activity.

The autonomic measures presented a more complicated picture. The volume pulse measures from the electronic plethysmogram were significantly smaller for the discrimination group while other autonomic measures did not seem to differentiate between the two groups. A possible explanation for these results was suggested by the different patterns of response in the two groups. It was found that all of the autonomic measures for the control group correlated negatively (three correlations were significant) with the muscle tension in the active arm. However, two of the autonomic measures for the discrimination group correlated significantly positive with muscle activity. The cancelation effects of these different patterns of autonomic activity offer possible explanation for the inability to establish differences between the two groups.

Microfilm \$2.50; Xerox \$6.00. 75 pages.

A STUDY OF THE PERCEIVED SIZE OF PROJECTED AFTERIMAGES IN DELUSIONAL AND NON-DELUSIONAL SCHIZOPHRENIC GROUPS

(L. C. Card No. Mic 60-1515)

Alan Mitchell Hartman, Ph.D. Washington State University, 1960

Supervisor: Dr. Francis A. Young

This study utilized fifteen trained observers (ten males and five females), fifteen chronic delusional schizophrenic males, fifteen chronic non-delusional schizophrenic males, and fifteen normal males. The Ss measured their projected afterimages in a reduced distance cue situation at three projection plane distances: 6.75 inches, 43 inches, and 90 inches. All subjects used three AI size measurement methods as follows: (1) remotely controlled outlining rods situated at the 43- and 90-inch distant projection screens, (2) a moving comparison square, and (3) a diaphragm comparison square.

The construction of the apparatus and the nature of the perceptual phenomena--AI size changes--used as a dependent variable made it possible to replicate Edwards' study of AI size change in a reduced distance cue situation. The findings of the present study were as follows:

- The Ss did not report changes in the apparent size of the AI when distance cues were added to the reduced cue situation described by Edwards.
- The Ss did report changes in the apparent size of their AIs when the projection screens were set at 6.75- and 90-inch distances.

It was concluded that since the ratio of AI area to projection screen area subtended at the S's retina was constant for the three projection distances, one to ten, accommodation and convergence cannot be ruled out as critical variables in perception of AI size change when the projection plane is closer to the S than the original AI stimulus induction object.

The purpose of this study was to test the following hypotheses:

 The chronic delusional schizophrenic demonstrates a higher degree of perceptual constancy than do the non-delusional schizophrenic and normal, and therefore will be less likely to respond as would be

- predicted on the basis of Emmert's "Law," i.e., perception of AI size change as the projection distance varies.
- 2. The delusional schizophrenic does not have a physical basis for the perception of constancy of projected AI size when the distance of the projection screen varies.
- There is no difference in the ability of the groups to measure the size of the AI with the three measurement methods.
- 4. Comparison of anxiety levels in the groups as measured by the Taylor Manifest Anxiety Scale and measures of perceptual constancy will show the following:
 - (a) The normal group will manifest low anxiety and perceive AI size changes as predicted on the basis of Emmert's "Law."
 - (b) The non-delusional schizophrenic group will manifest the most anxiety and will respond as predicted on the basis of Emmert's "Law."
 - (c) The delusional schizophrenic group will be intermediate in manifest anxiety but will perceive AI size change in a manner which would suggest perceptual constancy.

It was concluded that the first three hypotheses were confirmed. The fourth hypothesis was confirmed for group constancy and anxiety scores; however, correlations based on individual scores were in the order expected but were not significant. Microfilm \$2.50; Xerox \$4.60. 87 pages.

A MULTIDIMENSIONAL RATIO SCALING ANALYSIS OF PERCEIVED COLOR RELATIONS

(L. C. Card No. Mic 60-1479)

Carl E. Helm, Ph.D. Princeton University, 1959

The present study was designed to provide information relevant to the development of a uniform color scale, and also to investigate the relations between two different multidimensional scales.

A uniform color scale is a model for the representation of the perceived relations amongst colors. It is typically conceived of as a three-dimensional Euclidean space containing all possible colors, in which the distance between two colors represents the amount of perceived difference between them, and in which direction coincides with attribute. Only limited success has been achieved in constructing such a model. Part of the difficulty appears to be due to a lack of appropriate data describing the general similarities in suitable samples of colors. It was suggested that the multidimensional scaling procedures are ideally suited for the determination of such information.

Two multidimensional successive intervals studies had been carried out previous to the present research to provide such information. However they had given results which were at variance with both the classical notions of color relations and the implications of other more limited multidimensional studies. It was then shown that these anomalous results were due to a bias in the interpoint distance estimates (i.e. an underestimation of "big" distances). It was suggested that one possible source of this bias might lie in the scaling method used. Thus the successive intervals procedure assumes that $p_{i\,g}$, the probability of the ith stimulus being placed above the gth category boundary reflects the difference in scale values of the two elements. If, however, the subject's judgment reflects the ratio of the two scale values, then the successive intervals analysis will produce a logarithmic transformation of the scale which most simply describes the subject's behavior.

A multidimensional triads ratio judgment experiment was carried out on a set of color chips using ten normal subjects and four subjects with defective color vision. The data were analyzed separately for each individual and also for the ten normal subjects combined. The results for all the normal subjects were highly similar and were generally very close to that given by the Munsell notation.

The results for the color deficient subjects departed from those of the normal subjects in having a shortened red-green axis and in having more than two dimensions. The added dimensions appear to be due to an underestimation of big distances, particularly in the red-green direction. These results, when considered together with those for the normal subjects support the notion that the multidimensional triads ratio scaling procedure provides a reasonably accurate description of the perceived relations among colors.

A direct comparison was made of the interpoint distance estimates obtained from the multidimensional triads ratio judgments and those obtained from an earlier multidimensional successive intervals experiment. The ratio results were logarithmically related to the successive intervals results. The fact that no bias was observed in the triads ratio judgment results suggests that this procedure is the more appropriate technique for scaling color relations.

Microfilm \$2.50; Xerox \$4.20. 76 pages.

THE EFFECT OF SUBLIMINAL STIMULI UPON PERCEPTUAL DISCRIMINATION

(L. C. Card No. Mic 60-1332)

Harriet E. Hollander, Ph.D. University of Pittsburgh, 1959

The effects of certain kinds of subliminal stimuli on perception were investigated in this study. Specifically, thresholds for the perception of nonsense syllables were measured as a function of their association with subliminal taboo or neutral words or with a subliminal nonverbal stimulus.

The hypotheses were that: (a) different conditions of subliminal stimulation would have differing effects on the discrimination thresholds for nonsense syllables; (b) the presence of a nonverbal subliminal stimulus would lead to lower discrimination thresholds for nonsense syllables than the presence of either a taboo or neutral verbal subliminal stimulus; (c) discrimination thresholds would be higher for nonsense syllables associated with a taboo rather than a neutral subliminal stimulus; (d) that withdrawal of

taboo or neutral subliminal stimuli from the paired presentation with nonsense syllables would lead to a threshold decrease for those syllables; and (e) subliminal stimuli would not be discriminated at better than chance levels on a subsequent recognition test. Adaptation effects for the perceptual task were also explored.

The relevant perceptual task for all subjects was the correct identification of eight nonsense syllables presented tachistoscopically. A nonsense syllable was repeatedly presented until recognition occurred. Each nonsense syllable was preceded by a subliminal stimulus. Subjects were required to report only the nonsense syllables.

Stimulation levels for the nonsense syllable and the subliminal material were determined for each individual. The subliminal stimuli were presented at the lowest illumination level at which a subject could perceive a single letter. The nonsense syllables were presented halfway between the illumination level required to perceive a single letter and the level required for perception of a full word.

There were four parts to this investigation. The first part of the study consisted of a pre-experimental phase in which liminal and subliminal thresholds were established for each subject. The second and third parts of the experiment consisted of two discrimination phases. In Discrimination Phase I. Ss identified nonsense syllables associated with subliminal taboo words, or subliminal neutral words, or a series of subliminal dashes. Subjects participated in one of three experimental conditions. In Discrimination Phase II, the same list of nonsense words was repeated. However, for this second presentation, half the subjects in the taboo and neutral subliminal conditions were no longer presented with the subliminal words. In the fourth part of the experiments Ss were asked to identify the eight subliminal words that had been presented during the experiment. The eight critical words were combined with sixteen control words for the recognition list. Subjects in the nonverbal subliminal stimulus group were asked to report verbally which of a series of geometric forms they had seen.

Sixty volunteers from the Nursing and Dietetic services of the Leech Farms Road Veterans Administration Hospital served as subjects. Ten males and ten females participated in each of the three conditions of subliminal stimulation.

The following results were obtained:

1. The general hypothesis that variation in the content of subliminal stimuli can modify perceptual discrimination for nonsense syllables was supported.

2. On the recognition tests, Ss failed to discriminate, at better than chance levels, the subliminal stimuli that had been presented.

3. The presence of nonverbal subliminal stimuli had the least interfering effect on perception of the nonsense syllables and significantly facilitated adaptation to the perceptual task.

4. When the presence of taboo and neutral subliminal stimuli was compared, it was found that the presence of subliminal taboo words significantly facilitated rather than retarded the recognition of nonsense syllables. This effect was dependent on the frequency of presentation of subliminal stimuli prior to the exposure of nonsense syllables.

5. Women showed significantly greater variation in their responses to taboo and neutral stimuli than did men.

The subliminal effect was believed to depend on the

selection of an appropriate threshold level and on frequency of presentations. Perceptual facilitation as a function of the presence of subliminal taboo words was thought to be based on the avoidance of taboo words.

Microfilm \$2.50; Xerox \$4.00. 75 pages.

CONDITIONED HUNGER DRIVE IN MONKEYS

(L. C. Card No. Mic 60-1516)

Thomas C. Howard, Ph.D. Washington State University, 1960

Supervisor: Dr. Francis A. Young

A review of the literature concerning learnable drives and rewards reveals a number of studies reporting learned fears and as many studies dealing with learned rewards based on hunger. Of the half dozen or so studies dealing with learned appetite drives, only one is believed to be free of experimental or interpretive error.

An attempt to obtain conditioned hunger drive in monkeys is reported. Three groups of monkeys were exposed to a flashing light (the CS) for a period of 30 minutes once daily for 47 days. The animals were on a $23\frac{1}{2}$ -hour deprivation schedule. The drive group received the CS prior to feeding, the incentive group during feeding, and the control group after feeding. Concurrently with this conditioning, the animals were trained in the use of washers to obtain a food reward from a food vendor.

Subsequent testing of the animals under satiation, with and without the CS present, failed to produce differences between the groups attributable to the CS on either the rate of response on a previously learned food vendor response or progress in the learning of a new instrumental response to obtain washers as secondary rewards (with the CS only). Testing in the learning of this washer dispenser response under mild food deprivation revealed substantial learning for some animals.

It was concluded that:

- 1. There is no evidence for the conditioning of the hunger drive.
- Results indicating learning to obtain learned rewards, not retained until used, are ambiguous and confounded by possible manipulative drive.
- There is sufficient evidence to warrant the conclusion that the persistence of this washer-dispenser response is partly dependent upon the secondary reward value of the washers.

Microfilm \$2.50; Xerox \$3.80. 66 pages.

EFFECTS OF HEMICEREBRECTOMY IN RHESUS MONKEYS ON PERFORMANCE OF TWO DELAYED RESPONSE TYPE TASKS

(L. C. Card No. Mic 60-1338)

Donald Curtis Kruper, Ph.D. University of Pittsburgh, 1959

Little data are available concerning the psychological effects of hemicerebrectomy in monkeys. This operation involves the unilateral removal of all cerebral structures lateral to the hypothalamus, and rostral to the mesencephalon. As part of an evaluation of this surgical procedure, ten immature, Rhesus monkeys were tested on two relatively standard tasks. Five of these subjects received the operation and the others served as normal controls.

An object-quality discrimination task was modified to include an independent variable of randomly presented inter-trial delays. This variable was used to investigate retention, an ability that would seem to be a minimum requirement for normal learning. Performance by the normal animals, on the delayed object-quality discriminations (DOQ), was significantly better than that of the operated group, on the task as a whole. However, the groups were significantly different on only two of the four delay intervals, i.e., the 40- and 80-second delays. Neither the 20-second nor the 120-second delay intervals showed significant differences between the groups. When the scores for intervals of different length, within the same group, were compared, the following relationships to the 20second interval scores were noted: (a) The operated group showed significantly lower performance on each of the longer intervals; and (b) The normal group showed significantly lower performance on only the 120-second interval. Despite the facilitory effect of the multidimensionality and differential reinforcement characteristics of the stimulus objects inherent in the object-quality discriminations, the findings of this experiment seemed to indicate that the delays interfered with retention, especially for the operated subjects.

The delayed alternation task (DA), is a reliable test which has rarely shown a performance deficit as the result of unilateral brain damage in monkeys. However, because of the extensiveness of unilateral extirpation in the hemicerebrectomized monkey, this task was also chosen to evaluate behavioral effects of the operation. Little indication was found that the ten-second delay interval, in this experiment, was important. Therefore, the significant difference between the groups on this task, as indicated by the Mann-Whitney U procedure, was attributed to a tendency of the operated subjects to perseverate, or fail to alternate from a nonrewarded side. Various explanations for this perseverative tendency were attempted, but none was found adequate. The data suggested that present information regarding alternation behavior itself should be integrated and studied further, in order to understand better results of brain function experiments which utilize tasks involving this factor.

Although the data in both experiments indicated that these hemicerebrectomized monkeys could achieve relatively high levels of performance, they were found to be significantly inferior to the normal animals. This difference, although significant, seemed to be surprisingly small compared to what one might expect from such a radical surgical procedure. Thus, hemicerebrectomy in monkeys

did not seem to produce severe restriction in residual capacity for learning or retention.

With due caution regarding inferences from the monkey to the human organism, the writer is of the opinion that discouragement of a selective use of hemicerebrectomy is not clearly indicated. Further psychological evaluation of humans on whom this surgery is to be performed, should be carried out under well controlled conditions. This program would be extensive and would require interdisciplinary effort. However, such a program would be necessary if an adequate evaluation of hemicerebrectomy is to be made. Microfilm \$2.50; Xerox \$3.80. 67 pages.

THE CUE VALUE OF CERTAIN ATTRIBUTES OF FACES

(L. C. Card No. Mic 59-6286)

Joseph William Openshaw, Ph.D. The University of Tennessee, 1959

Major Professor: W. O. Jenkins

An experiment in human learning was conducted in which subjects learned to sort black and white photographs of adult male faces. The effectiveness of two different kinds of attributes of the faces as cues for the sorting task was investigated. The kinds of attributes were personality traits and physiognomic traits. Previous research by other investigators had demonstrated that college students agree in attributing these kinds of traits to photographs of faces.

In the present study photographs were rated on a number of personality traits and physiognomic traits by a group of college students. Then, on the basis of these ratings, sets of photographs were selected that were dichotomous with respect to a bipolar personality trait or a bipolar physiognomic trait. Each of these two classes was represented by two traits employed as cues in separate sorting tasks which constituted the major part of the experiment. The personality traits employed were designated Warmth-Tolerance and Moral-Social Responsibility; The physiognomic traits were Age and Complexion. In addition there was a control condition in which the subjects learned to sort a like number of photographs into an artificial dichotomy. Thus there were five conditions and a different group of subjects was employed in each, forming an "independent-groups" type of experimental design.

In every case experimental subjects were required to learn to sort correctly first one set of photographs and then a second set, both of which were dichotomized on the basis of the same trait. The control subjects merely learned to sort two consecutive sets of photographs in which there was no cue or principle available to distinguish between the two categories. This procedure produced measures of cue effectiveness in both original learning and in transfer of training.

Thirty-five college students served as subjects in the learning and transfer experiment. None of these were persons who participated in the preliminary part of the experiment in which the photographs were rated. The subjects were assigned to the various conditions so that

each group contained five males and two females. The resulting factorial design permitted testing for possible differences in performance that might be attributed to sex of the subjects.

The results showed that college students can learn to respond to personality traits and to physiognomic traits in photographs of faces. Learning was facilitated significantly in all experimental conditions where traits were available as cues in contrast to the control condition where traits were not available as cues. However, comparisons among the experimental groups produced no evidence that one type of trait serves any more effectively as a cue than the other type. Instead it was found that traits of the same type differed widely in their effectiveness as cues.

Results on the transfer tasks were consistent with the findings in the original learning. Positive transfer occurred in all conditions, but in general, there was no evidence of greater transfer for tasks based on personality traits than tasks based on physiognomic traits. There was strong evidence of greater transfer in every case where traits were available as cues than in the control condition where no trait was available. But there were also sizeable differences in the amount of transfer associated with traits of the same kind.

The subjects' ability to verbalize accurately concerning the principle involved in sorting the photographs was found to correlate highly with the amount of transfer which occurred. Again the results presented the pattern found before, suggesting no consistent difference in the cue value of the two types of traits for the verbal process either, but sizeable differences between traits of the same type.

The experiment produced no evidence that the sexes differ in performance on any or all of these tasks.

Microfilm \$2.50; Xerox \$4.40. 83 pages.

REDUCTION OF STRESS SYMPTOMS IN THE ALBINO RAT: A DIFFERENTIAL EVALUATION OF THE STRESS RESPONSE IN ALBINO RATS GENTLED MANUALLY AND PHARMACOLOGICALLY.

(L. C. Card No. Mic 60-1082)

Murray Stanley Plissner, Ph.D. New York University, 1959

This study investigates, measures and evaluates the effects of early gentling of albino rats by manual extrahandling as compared with early gentling with a drug, reserpine. The problem is to determine the comparative effects of the two gentling methods by studying certain physiological changes produced by subjecting the animals to a stress situation.

The following procedures were used in the investigation. Forty-eight male albino weanling rats were divided randomly and equally into three groups. One group was gentled for ten minutes daily by manual extra-handling. Another group of animals was gentled by daily subcutaneous injections of reserpine. The remaining animals served as unhandled controls.

After twenty-eight days of gentling and a seven day interval during which all animals were unhandled, a stress formula was imposed upon all groups. The stress consisted of immobilizing each animal on its back for a period

of forty-eight hours without food or water. At the end of the stress period all animals were sacrificed and autopsies were performed.

Measurements to show the physiological response to gentling and to the stress formula were taken before, during and after the experimental period. The measurements were designed to include:

- 1. physical growth by recording body weight and body length
- 2. physiological changes as measured by adrenal gland weight, thymus gland weight, number of ulcerations of the gastric and duodenal mucosa and blood eosinophil counts.

The results of the experiment are as follows:

- 1. Extra-handled animals gained significantly more weight than either drug-injected or unhandled control animals. No significant difference in weight occurred between drug-gentled and unhandled control animals.
- 2. Extra-handled animals grew significantly longer than either the drug-gentled or the unhandled control animals. No significant difference occurred between the skeletal growth of drug-gentled and unhandled control animals.
- 3. The adrenal glands of extra-handled animals, after stress, were significantly lighter in weight than the adrenal glands of either drug-gentled or unhandled control animals. No significant difference in adrenal gland weight occurred between drug-gentled and unhandled control animals.
- 4. There was no significant difference between the weights of the thymus glands of extra-handled and druggentled animals after stress. However, the thymus glands of both extra-handled and drug-gentled animals were significantly heavier than the glands of unhandled control animals.
- 5. The number of gastrointestinal ulcerations sustained by extra-handled animals was significantly smaller than that sustained by either drug-gentled or unhandled control animals. There was no significant difference between the number of ulcerations sustained by drug-gentled and unhandled control animals.
- 6. Blood counts of all animals showed a severe eosinopenia.

The test results and analysis of the data permit the following conclusions to be drawn:

- 1. With the exception of the eosinopenia which was apparently resistant to modification in all experimental animals, manually gentled rats sustain less physiological damage due to stress than either drug-gentled or unhandled control animals.
- 2. The administration of reserpine does not significantly modify the physiological response to a stress situation.
- 3. The effects of early gentling with reserpine are transitory and are no longer in significant evidence after a period of seven days.
- 4. Within the limits set by the experimental conditions manual gentling appears to be superior to reserpine in offsetting the physiological response to a stress formula.

 Microfilm \$2.50; Xerox \$4.60. 86 pages.

STIMULUS AND STIMULUS-CHANGE FACTORS GOVERNING THE FREE OPERANT RATE

(L. C. Card No. Mic 59-6383)

Carl Lester Roberts, Jr., Ph.D. University of Missouri, 1959

Supervisor: George Collier

Recent experimentation has shown that the onset of a light following an operant increases the frequency of the operant over its unconditioned emission rate. The frequency of the operant also decreases when light onset is subsequently withheld.

Further, it has been found that the operant rate, under light-onset reinforcement, decreases over time within response sessions, but also is higher within these sessions the longer the intersession interval.

The present investigation was designed to discover whether this decremental relation and the increment over time should be attributed to the occurrence or non-occurrence of the operant's consequences, to the occurrence and non-occurrence of the operant as such, or to the operation of these two elements jointly.

One hundred twenty male albino rats were divided into five equal groups. All groups were treated identically in phase one of the experiment. Subjects were given three 20-min. sessions at 24-hr. intervals during which they could illuminate a striped panel by pressing a lever. Next, each group was presented for two consecutive experimental sessions with one of five component combinations of a lightonset reinforcement situation. Group 1 was allowed access to a lever only; group 2 was given repeated illumination of a striped panel and a lever. Operation of this lever did not produce the illuminations, however. The illuminations for the subjects in this group were produced by remote control by matched subjects in group 3. Group 3 was given access to the lever with illumination of the striped panel contingent upon the depression of it. Group 3 also illuminated the striped panels for group 4 subjects, who had no lever available. Group 5 was given neither lever nor illuminations, but was simply placed in the dark apparatus for the two sessions.

Finally, subjects were tested for the effect of the exposure condition on renewed responding for the illuminated striped panel, as well as for the effect of a new visual pattern. Four replications of the experiment were run.

Analysis of the data confirmed earlier observations that illumination onset contingent upon a response reinforces that response and that the removal of this contingency leads to extinction. However, presentation of repeated illuminations in the absence of the lever produced a recovery rather than a decrement in subsequent, light-onset--contingent lever-pressing. The degree of recovery did not differ reliably from that of the group given neither light onsets nor the lever during exposure sessions.

On the basis of these findings, an interpretation of the typical decline in responding during response sessions and the recovery of response strength between sessions was given in terms of a two-process model. First, the occurrence of any response produces a decrement in the probability of the response's subsequent occurrence. There is recovery from this decrement with time so that the level of responding is a joint function of the number and rate of response occurrences and of the between-

sessions interval. Second, the occurrence of a response contingency (reinforcer) produces an increment in the probability of response which does not dissipate with time. Conditions which do not allow the response to occur will allow its recovery from the cumulative decremental effects independently of whether the previous consequences of the response occur.

Microfilm \$2.50; Xerox \$3.60. 64 pages.

THE NONNUTRITIVE SUCKING BEHAVIOR OF THE INFANT RHESUS MONKEY

(L. C. Card No. Mic 60-1508)

Lorna Joanne Smith, Ph.D. The University of Wisconsin, 1960

Supervisor: Harry F. Harlow

Experiment I was inspired by the theoretical controversy of whether thumbsucking in children is caused by compensation for insufficient sucking during feeding as argued by inborn oral-drive theorists, or whether thumbsucking is in fact due to nutritive sucking experience and enhanced by the association of sucking with primary reinforcement as maintained by acquired oral-drive theorists. The nonnutritive sucking of eight bottle- raised monkeys was compared with that of eight cup-raised monkeys from birth to six months of age. The bottleraised infants, required to suck extensively during feeding, showed far more nonnutritive sucking than the cup-raised infants, and thus the results supported the acquired-oral drive theory. This theory does not serve as a complete explanation of oral behavior, however, for counterbalanced variables unrelated to feeding experience were also found to be important. Males showed significantly more nonnutritive sucking than females, and monkeys with rockingmother surrogates, significantly more than those without. Whereas feeding experience affected nonnutritive sucking most at early ages, the sex and mother-surrogate variables were most important during the terminal 3-mos. of the experiment.

Nonsucking oral-activity, such as biting and licking, was also studied, and variables affecting nonnutritive sucking were generally found to inversely affect nonsucking oral activity. Cup-fed monkeys exhibited significantly more nonsucking oral-activity than bottle-fed animals, and females, significantly more than males. The relationships of nonnutritive sucking and nonsucking oral-activity were discussed along with additional evidence of universal and persistent oral responsiveness of the monkey to conclude that although there is not compensatory nonnutritive sucking, there is, indeed, an inborn oral drive.

Restraining five infant monkeys on one side of a Plexiglas screen with highly preferred fruit on the other, and comparing their oral behavior with that of five control animals, it was demonstrated in Experiment II that nonnutritive sucking increased with frustration.

Presenting stimuli rated for emotionally disturbing qualities by laboratory personnel, and by frequency of occurrence of crouching and rocking behaviors, it was found in Experiment III that mildly disturbing stimuli increased nonnutritive sucking whereas more disturbing stimuli decreased it.

The apparatus used for the experiments was a cylindrical Plexiglas observation cage enclosed within a masonite chamber equiped with one-way vision glass. Total nonnutritive sucking and nonsucking oral-activity scores

were the number of 10-sec. periods out of 25 in which nonnutritive sucking and nonsucking oral-activity were exhibited, respectively.

Microfilm \$2.50; Xerox \$5.40. 106 pages.

RELIGION

THE PERSISTENCE OF THE "ELIHU"
POINT OF VIEW IN LATER JEWISH LITERATURE

(L. C. Card No. Mic 60-1387)

Roger Norwood Carstensen, Ph.D. Vanderbilt University, 1960

Supervisor: Professor J. Philip Hyatt

The question of this study is: Do writings subsequent to the book of Job suggest the historic survival of the viewpoint reflected in the Elihu speeches? Such materials, related to him by historical rather than by literary ties, could be of particular value in understanding Elihu himself.

The procedure adopted was to analyze what Elihu said in its Joban context, and then to examine the sources for evidence of the persistence of his views. Included were the Wisdom books of the Apocrypha, the Wisdom Psalms, the Pseudepigrapha, and Tannaitic sources in the Midrash and Talmud.

The analysis indicated that these speeches (a) are a didactic, polemical insertion, intended to supplement and correct the original, and (b) embody a point of view which, while to some degree a development of ideas in the earlier drama, is distinctive. That such an insertion was successfully made argues that it then represented a distinct body of community opinion.

The Wisdom of Solomon, contrasting to Ecclesiasticus at practically all major points of coincidence with Elihu, exhibits a conclusive affinity with the latter. Both attack traditional Wisdom; both claim, through a special charisma, a saving gnosis by which man may escape death. Elihu implicitly, and Wisdom explicitly, teach a differentiation between the good and the evil in the afterlife as a solution to the problem of theodicy. They deduce God's justice from His power; self-sufficient and impartial, He works in the moral as in the natural order. To both, suffering is a warning to all men, and a blessing to some or a curse to others, depending upon their response to it. Neither is really nationalistic; each senses election simply to be God's acceptance of the righteous.

Psalms 49, 73 and 139, charismatic and non-nationalistic in tone and content, are related to the Elihu speeches. They find in life or death the answer to the problem of theodicy, and move characteristically toward the "afterlife" solution.

These works all form a corpus of Wisdom materials of the "Elihu" school; they decisively attest the existence and self-conscious survival of a Wisdom school which apparently split away from traditional circles early in the Joban period and, in Elihu and subsequent sources, became more and more sharply defined. This corpus, carefully used, puts at the disposal of scholars a unique historical commentary on the Elihu speeches in particular, and the book of Job in general.

The <u>Testament of Job</u> and the Tannaitic rabbis give some evidence, though fragmentary, that in later times the name Elihu was associated with an obscure branch of Ophitic Gnostics who specialized in esoteric knowledge-particularly that of the "serpent" and/or "leviathan." In the <u>Testament</u>, a later interpolation gives Elihu a demonic role, and disposes of him by excommunication; this supports, though not conclusively, the hypothesis of the Elihu insertion in the book of Job.

These references do not decisively indicate that a continuous "Elihu" tradition survived into New Testament times; the use of his name may have been literary in origin. Nevertheless, the gnostic idea of salvation through knowledge is clearly in Elihu, and the extravagances of classic Gnosticism are anticipated in his charisma, his claim to understand the mysterious purposes of God, and his interest in the attainment of life beyond death. The Elihu speeches, through their connection with Hellenic Wisdom and the early Ophites, describe the point of impact at which the Joban revolution in traditional Wisdom circles made its strategic contribution to that blending of Hebrew and non-Hebrew elements from which both Gnosticism and Christianity emerged.

Microfilm \$4.10; Xerox \$14.40. 317 pages.

THE RELIGIOUS IDEAS OF SOME MAJOR EARLY WRITERS OF AMERICA

(L. C. Card No. Mic 60-383)

Robert Walter Root, Ph.D. Syracuse University, 1959

Please see abstract on page 4378.
Microfilm \$12.65; Xerox \$45.05. 1001 pages.

SOCIOLOGY

SOCIOLOGY, GENERAL

THE CONCEPT OF SECULARIZATION
AS A SOCIAL PROCESS

(L. C. Card No. Mic 60-1237)

Russell Barta, Ph.D. University of Notre Dame, 1960

One important aspect of the relationship between religion and society is the process of secularization. When it is said that a social system has become secular it is not quite clear whether such a characterization is being applied to the individuals as such in the society or more exactly to the type of social unit. Furthermore, it is not certain what is meant precisely if we assert that a society or social unit is secular. It has been repeatedly pointed out that the trend in Western Civilization has been in the direction of increasing secularization. Although such a characterization is highly suggestive, the concept is far from well defined.

An examination of the sociological literature on the subject indicates that "secularization" has at least two different meanings, each meaning suggested by its own tradition in social science. It can refer to the general, historic movement whereby tradition as such loses its power to influence social action. The author prefers to refer to this trend as "rationalization" in the Weberian sense. Secularization can also refer to that social process whereby religion ceases to be a constitutive element of inclusive social systems. It is in this sense that the author prefers to use the term.

He arrives at this understanding of secularization by examining closely four typical examples of religio-centric communities: St. Denis, studied by Horace Miner; Cantonville, by Everett C. Hughes; the Polish community in Chicago, by Thomas and Znaniecki; and finally, the Polish community in South Bend, as the result of field work done there in 1952. He discovered that in these communities: a) the participants defined their membership in the social system to include religion as an essential element, b) participation in the religion in one way or another determined accessibility to the social system, c) in each case, it was functionally difficult to participate in the social system without accepting and acting according to the religious values present there.

Joining these insights with the recent contribution of sociologists to an understanding of an organized group, the author concludes:

- a) That for a religion to become a relevant element in inclusive social systems, it would have to enter the system via the classificatory, existential and constituent elements of the ideal pattern underlying the social system. In the event of such a relationship between religion and the social system, there would result a religio-centric community.
- b) that secularization would be that social process

whereby religion ceases to enter into the organized group's image or definition of itself and membership in a specific religion would no lorger be a requirement for participation in the social life of the group.

Secularization would refer to the decline of religion as a bond of some inclusive social system.

The problem of individual religiosity is to be distinguished from the role of religion in social systems. The secularization of society is not to be confused with the secularization of individuals as such. A secular individual is a problem different in kind from the secular social system.

The sub-groups of universal religious bodies like Roman Catholicism have at times and under certain sociological conditions become constitutive elements of inclusive social systems, approximating what Wach calls the "identical group."

Microfilm \$2.50; Xerox \$8.00. 172 pages.

SOME FUNCTIONAL THEORIES OF RELIGION AND THEIR PHILOSOPHICAL BASES: AN ESSAY IN THE INTEGRATION OF PHILOSOPHY, RELIGION AND SOCIAL SCIENCE.

(L. C. Card No. Mic 59-6296)

Robert Charles Browne, Ph.D. Syracuse University, 1959

Please see abstract on page 4408.
Microfilm \$2.50; Xerox \$7.60. 163 pages.

STRUCTURE AND FUNCTION: AN ANALYSIS OF THEIR ANTITHESIS IN THE BEHAVIORAL SCIENCES AND THE STUDY OF EDUCATION.

(L. C. Card No. Mic 60-1363)

JB Lon Hefferlin, Ph.D. Stanford University, 1960

One of the most basic conceptual dichotomies in the history of science has been that of "structure" and "function" -- that between what a thing is and what it does. Today it recurs throughout the sciences in the separation of object and activity, matter and force, noun and verb, anatomy and physiology, status and role, and statics and kinetics.

The utility of "structure" and "function" for scientific research is limited, however, by the variety of concepts that they embrace. Because inadequate conceptual distinctions lead to inadequate empirical research, numerous scholars have been concerned with the lack of precision of both "structure" and "function." This dissertation

analyzes the concepts that are contained in the joint use of the terms, and includes three parts: an analysis of the concepts themselves, a review of their use in various behavioral sciences, and their application to the study of institutionalized education.

In Part One "structure" and "function" are illustrated as containing at least three distinct conceptual dichotomies. The first is that between any object or entity (a "structure") and any type of interdependent relationship. This dichotomy of entity and relationship is shown to be rooted in the mechanism of human perception and in the organization of human language.

A second dichotomy involves an object not as a structure but as having a structure. Here "structure" means the internal relationships within the object; "function," the relationships external to the object -- between it and other objects. In this sense, structural analysis means a study of an object's components, while functional analysis means a study of its relationship to other phenomena.

A third conceptual distinction is one between three types of relationship: stable or static relations which are frequently labeled structure, cyclic processes such as activity or cause and effect which are labeled function, and a third type of process that is cumulative rather than cyclic which is termed "change." It is suggested that in most scientific research these various concepts are combined, in that structure generally indicates stable internal relationships while function indicates cyclic external relationships.

In Part Two these distinctions are observed as they are used in the biological sciences, psychology, anthropology, and sociology. In the biological sciences, for example, while anatomy and physiology have traditionally been distinguished in terms of the third meaning of structure and function -- that between the examination of stable position and the study of cyclic processes -- they cannot be differentiated in terms of the other meanings of the dichotomy. In psychology, however, the second meaning of internality and externality has been widely employed to separate the structural analysis of components from the functional analysis of effects. In the social sciences, on the other hand, the distinction between statics and dynamics has prevailed. Here the concepts' use by Comte, Spencer, Durkheim, Malinowski, Radcliffe-Brown and others is examined, as well as the more recent development of structural-functional analysis in sociology -- an approach, interestingly enough, concerned not with the multitudinous functions of social phenomena, but with the conditions necessary for the phenomena's existence.

Part Three applies these conceptual distinctions to the study of educational institutions and particularly to the analysis of American higher education. It is here illustrated that the structure-function concept can be used differently at each of three different levels of research: the study of individual roles, of institutions, and of the entire system. The dissertation ends with an analysis of this usage in one such study, that of W. H. Cowley at Stanford.

Microfilm \$3.65; Xerox \$12.85. 281 pages.

A STUDY OF THE PROBLEM OF DIFFERENTIATING ALCOHOLIC CRIMINALS

(L. C. Card No. Mic 60-1517)

James William Kelsaw, Ph.D. Washington State University, 1960

Supervisor: Dr. Vernon Davies

The purpose of this study was to investigate the problem of differentiating alcoholic-offender groups. The problem has been traditionally defined as differentiating alcoholic criminals from criminal alcoholics or distinguishing offenders who are "primarily criminals" from offenders who are "primarily alcoholics."

The approach in this study was to ascertain whether there were traits which differentiated three groups designated AP, NAC, and AC. The AP group was a sample of patients who underwent treatment for alcoholism at a private hospital. The individuals of this group were considered to be primarily non-criminal in the sense that they did not have extensive arrest and conviction records. The NAC group was a sample of convicts who were non-alcoholics. This group was made up of inmates of a state penitentiary. The AC group was a sample of convicts who underwent treatment for alcoholism at state expense in the branch of a hospital devoted to treating alcoholics. The traits of comparison were selected from adult social relationships and other factors, childhood and adolescent experiences, drinking histories, and criminal careers.

The socialization process and differential access to opportunity-structures were suggested in the review of literature as possible theoretical frames of reference.

It was found that alcoholic-offender groups may be differentiated on the basis of the mode of adult adaptations they are pressured into making by their differential access to the means (legitimate or illegitimate) in the societal opportunity-structure. Alcoholic criminals are individuals making borderline retreatist-innovationist adaptations, whereas criminal alcoholics are in the main retreatists in their mode of adjustment. These can be determined by the interplay of the factors of age, drinking history, criminal career, marital stability, education, and occupational stability.

The findings imply that the obstructions to the progress in the understanding of both alcoholism and crime may be inherent not so much, as is suggested in current literature, in the failure to regard alcoholism and crime as different end results arising from variations in unconscious mechanisms, but rather, the obstructions are inherent in the failure of present clinical approaches to take account of the cultural forces that set up patterns of behavior and modes of adjustment, along with the objective conditions and factors in the life history of the individual that are indicative of pressures forcing him to act differently from the behavior pattern prescribed by the normative structure.

Individuals, after being actively oriented toward stable criminal careers and having lost out in the competitive struggle, may become alcoholics. Having lost out in the innovationist struggle, they adapt retreatist modes of adjustment. It is thus possible for alcoholic criminals to become criminal alcoholics. The traditional definitions of these terms, which imply that there are "primary alcoholics" and "primary criminals," are, therefore, misleading.

Microfilm \$2.65; Xerox \$9.25. 202 pages.

THE SOCIAL BASES OF WEST GERMAN POLITICS

(L. C. Card No. Mic 59-4075)

Juan J. Linz Storch de Gracia, Ph.D. Columbia University, 1959

This study examines the social determinants of political behavior and attitudes in post-war West Germany. It is a secondary analysis of a survey of 3246 persons representative of the total West German population which was carried out in 1953 by the Unesco Institut für Sozialforschung in Köln under the direction of Professor E. Reigrotzki. The essay deals with three major groups in the German electorate -- workers, middle class, and farmers -- in an attempt to locate social factors accounting for the identification of the voter with different parties.

After a general presentation of the German party system in comparative perspective and a discussion of each of the parties, their ideology, programs and appeal, the emerging three party system of Socialists, Christian Democrats and Liberals is described. Class and religion as determinants of party identification are examined and brought into proper perspective by comparison with other West European countries. Continual reference is made to materials in the historical, political science and sociological literature on German society and politics in the past to provide the necessary background for the study.

While the focus of the study is a detailed analysis of survey data, an attempt is made to link the empirical findings with theoretical writings about modern society and Western democracy. The problems of cleavage and consensus in a democratic multiparty system are linked with the traditional sociological problem of the web of group affiliations integrating the society. The consensus on the policies of Adenauer serves as a focus for this discussion. In that context the notions of cross pressures, conflicting loyalties, the position of the renegade, and climate of opinion are introduced. Thus, the role of unions, voluntary associations, size of city and size of plant as social contexts, and social relations on the job in heightening class interest and political awareness are examined. The empirical data support the theoretical propositions of men like de Tocqueville and Durkheim and theorists of mass society, and confirm the findings of recent studies like Union Democracy (Lipset, Colemand and Trow).

The three groups with which the study deals are examined in detail in an attempt to relate the multiple bases of social cleavage in German society to their political correlates: electoral and other forms of political participation, self-interest and concern about the election, and acceptance of a democratic party system, and foremost, party preference.

Detailed multivariate analysis of data on the worker group suggests a number of striking differences in political orientation, attitudes and behavior among German workers (associated with skill level, income, unemployment, job security, and work satisfaction), which in part confirm those found in other countries and in part show differences deserving of further research. For example, greater support for the Social Democratic Party among more privileged workers is a finding replicated in Sweden and Norway but not in other countries on which survey data are available.

The German middle class and the ideological orientation of different segments of it have been the subject of much discussion since the Thirties. Taking off from these, we explore in great detail the politics of the lower and upper white collar employees, civil servants, businessmen and artisans. Geiger's distinction between old and new middle classes proved very useful here. Considerable new data is presented on the political outlook of the growing white collar group; the same has been done in an attempt to explore empirically the theoretical problem of conservatism in small versus larger business.

The German rural social structure is contrasted with that of France and Italy. The historical background of rural politics, the Nazi strength among Protestant farmers, led us to examine the question of the farmer's poor understanding of the democratic process, their narrow pressure-group orientation combined with lack of wider political interest, etc. The traditional importance of generational conflicts in German society led us to explore the relationship between age and politics and led to the finding that the identification between social class and political party is less marked in the younger generation.

Throughout an attempt is made to link the presentation of new and extensive data with broader theoretical problems which have long preoccupied students of society and politics. Microfilm \$12.25; Xerox \$43.95. 977 pages.

A SOCIOLOGICAL ANALYSIS OF THE ROLES AND VALUE ORIENTATION OF AN OCCUPATION: VOCATIONAL AGRICULTURE TEACHING.

(L. C. Card No. Mic 60-1469)

Harold Lyle Nix, Ph.D. Louisiana State University, 1960

Supervisor: Professor Frederick L. Bates

This dissertation describes and analyzes the social relationships of an occupational position, that of the teacher of vocational agriculture in high school. The description and analysis include the general value orientation and structural stresses which are involved within and among the roles the vocational agriculture teacher performs.

Based on data derived from a review of appropriate literature and from twenty-seven four-hour interviews with vocational agriculture teachers in three selected parishes in Louisiana, the study uses a basically structural-functional approach in describing and analyzing the occupation. The study organizes the data by a model of behavorial causation in which social organization (modal behavior) and social disorganization are conceived of as functions of three basic groups of factors: (1) socio-cultural structure, (2) situational factors, and (3) personality factors. At the socio-cultural level, the study determines the general role definitions as well as general role or value conflicts of the vocational agriculture occupation by examing certain norms (and their associated goals, attitudes and values) in the light of role theory in connection with Parsonian pattern variables.

At the social organization level, the study focuses upon role stresses (role conflict, role frustration, role inadequacy, and role superfluity) and certain other consequences of the interaction process (role fulfillment, role satisfaction, occupational problems, and occupational change). The study finds the value orientation of the vocational agriculture teacher to be unusual for a member of a professional occupation. The conditions of the teacher's employment prescribe a basically achievement, universalistic, and collectivity-orientation; but these conditions combined with economic necessity require him to maintain a position of affective neutrality toward methods of farming. On the other hand, in the teacher's orientation the structural elements of Gemeinschaft appear to be associated with a positive affectivity toward rural people and toward farming as a way of life, with a collective rather than self-interest, and with a strongly diffuse orientation which prescribes a "community of fate" in which the teacher feels he should share the hardships and sorrows, joys and satisfactions of the rural people he serves.

The result of the unusual value orientation is that the most characteristic strain found within the "Vo-Ag" teacher roles is role superfluity. The modal actor's perception of the rapidly changing agricultural situation and the consequent decline in farm population create an unusual amount of role frustration. The membership of the "Vo-Ag" profession in two bureaucratic organizations and the resulting dual functions of the teacher's position give rise to role conflict. The most common role inadequacy is the teacher's lack of certain technical skills.

In spite of the structural maladjustments which give rise to these stresses, the modal respondent enjoys above average role satisfaction. This fact indicates the presence of compensating rewards and mechanisms for the amelioration of stresses. The "Vo-Ag" teacher's greatest rewards appear to be a "sense of public service" and "recognition." The mechanisms for alleviating structural strains seem to be (1) the isolation of role performance, (2) the formation of a semi-official organization, the advisory council, as a buffer between the two bureaucratic structures, (3) the formation of a hierarchy of role importance, and (4) a teaching philosophy which shifts the responsibility for decision making and synthesizes many aspects of vocational and general education.

The stresses in combination with the mechanisms cited are considered as primary factors leading to the following changes within the occupational structure of the "Vo-Ag" teaching profession: (1) an increasing educational orientation and a rejection of the "service" role, (2) a shift toward a more "localistic" orientation, (3) a tendency for "Vo-Ag" teachers to broaden the objectives of their profession to fit their accomplishments while holding on to the institutionalized means of accomplishing the former narrower cultural goals, (4) a growing dominance of the in-school roles at the informal but not at the formal level, and (5) an increasing integration of the position and roles of the "Vo-Ag" teacher into the public school system.

Microfilm \$5.50; Xerox \$19.60. 431 pages.

SOCIOLOGY, FAMILY

THE SOCIAL ROLE OF THE EXECUTIVE'S WIFE

(L. C. Card No. Mic 60-1330)

Margaret Louise Helfrich, Ph.D. University of Pittsburgh, 1959

This study of the various social roles of the wives of executives was designed to test the following hypotheses:

- 1) there are significant variables associated with role choice.
- 2) there are basic duties and responsibilities associated with each role.
- 3) there are individual variations in the behavior patterns within each role.
- roles are reciprocal in nature and role choice is dependent in part upon the role partner and the expectations of significant others.
- 5) there is, in some cases, a sequential role pattern; first wife as economic partner, then as housewife and mother, and finally as companion to her husband.

A pilot study was conducted using a questionnaire. The respondents were categorized by level of management of the husband and by role choice of the wife. Separate tabulations were made for (1) the managerial categories and (2) the role categories on background items including education, work experience before and after marriage, husband's level of management and salary, years married, number and ages of children, degree of organizational participation, and duties and norms associated with the role.

The pilot study led to a slight revision of the question-naire. The final form containing 19 questions, after reliability had been established, was distributed to the first sample containing 29 other-than-top-level and 21 top-level executives' wives. Most wives in the lower category accompanied their husbands to a conference entitled "Management Problems for Executives" at the University of Pittsburgh. Associates of the author aided in obtaining questionnaires from wives of top-level executives. Interviews with wives and some of the husbands provided supplementary data on behavior patterns.

The findings regarding the generalized role of the executive's wife confirmed the hypothesis that there are basic duties associated with this role. The duties listed by executives' wives are: (1) to care for the home, husband, and children, (2) to manage so that the husband gets a portion of the wife's time, (3) to entertain his business associates and their mutual friends, and (4) to participate in social and civic affairs. The norms of conduct include: (1) tact, (2) sociability, (3) adaptability, (4) patience and understanding, (5) reserve, (6) intelligence, (7) a sense of humor, and (8) good physical and mental health. Most wives of top-level executives think that the wife of an executive need not conform to a particular pattern of behavior; most wives in the lower status category think she should conform. Some wives qualified their answers by saying that conformity depends upon the reference group.

The wives of executives have six roles from which to choose: (1) family-centered, (2) community-centered, (3) career-centered, (4) consultant, (5) creative, and (6) wife as student. The most frequently chosen roles are

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family and community-centered. Family-centered wives emphasize the direct care of home and family; community-centered wives emphasize participation in socio-civic affairs. Most wives of top-level executives are community-centered; most wives in the lower status category are family-centered. More family-centered wives have attended college and business school, and have worked before and after marriage than have wives who are community-centered. Generally, the husband's salary and wife's level of civic participation are higher for the community-centered, their children are older, and they have been married longer than the family-centered. The median number of children for both categories is 2.5.

Role choice in the remaining categories may be a function of factors not included in this study. The three career-centered wives are teachers or social workers. The five consultants are direct consultants, advisors, or listeners. The six creative wives listed painting, writing or music as their activities. Only two women are full-time students although several are enrolled part-time.

Microfilm \$2.50; Xerox \$7.20. 155 pages.

RACIAL DEMOCRACY IN MARRIAGE:
A SOCIOLOGICAL ANALYSIS OF NEGRO-WHITE
INTERMARRIAGE IN BRAZILIAN CULTURE.

(L. C. Card No. Mic 59-6560)

Austin John Staley, Ph.D. University of Pittsburgh, 1959

This study is a survey, and to some extent, an analysis and evaluation of the socio-economic factors contributing to a climate permissive to Negro-white intermarriage. Secondarily, it is a test of the claims that Brazil's racial democracy goes beyond the political and economic spheres into the ultimate reaches of the intimate and personal relationships of marriage.

Because it offered one of the great laboratories for the study of racial democracy and because it permitted greater objectivity in the sociological analysis of an emotionally charged social relationship, Brazil was selected as the

site for this research.

The literature on racial intermarriage was reviewed under the following frames of reference: (a) causal factors; (b) patterns of incidence; (c) consequences for the partners and the children; (d) the social function of interracial marriage; (e) social thought. Further, a summary was made of the historical factors that shaped the interracial pattern in the Brazilian culture. An overview of the statistics on interracial marriage was also given.

For its method of both observation and data analysis the survey employed a multiple design. First of all, there was an interregional survey of attitudes toward interracial courtship and marriage. Two hundred and eighty-five secondary school students from five different regions in Brazil were given a questionnaire to discover how willing they would be to countenance cross-racial unions. Controlled were the variables of race, age, class, sex, percentage of Brazilian grandparentage, and community type (urban-rural, volume of foreign-born, ratio of Negroes to whites). Bartlett's test of homogeneity was employed and an analysis of variance was applied to the data to observe

the effect of region, class, grandparentage, and urbanrural birthplace and background.

Secondly, the design included focused interviews with 147 inter-racially married couples located in all three classes in all five regions. The data gathered included: (a) socio-economic backgrounds; (b) social pressure resultant from race prejudice: (c) open-end questions. To each person was given the specially designed Racial Definition Test to find out his subjective definition of "Who is Negro?" and a Racial Sensitivity Test set up to find out his rank order of sensitivity along an axis of primary and secondary relations. To some of the children of the intermarried a MAPS projective test was given to discover evidences of marginality. Randomness was not assumed for the sample of intermarried, and therefore only descriptive statistical summaries were made from these data. A typology of the intermarried was also attempted.

Finally, there was a content analysis of the oral (several hundred different sayings and opinions expressed by the students in the open-end part of the attitude questionnaires) and written (poems, plays, novels, as well as current popular songs) tradition in the Brazilian culture on the permissiveness to intermarriage of Negroes and whites.

In Brazil there is a sizable percentage of intermarriages in which both parties were completely unaware of racial prejudice. This contradicts the theory that interracial marriage goes against "nature's laws." However, varying degrees of prejudice against intermarriage were found in every region, in every class, in persons of all-, part-, or non-Brazilian grandparentage, and in persons from rural as well as urban birth or background. Permissiveness to cross-racial marriage varied inversely with the class status. Color seemed to supersede class as a dominant deterrent to cross-marriage when the white person's own family is involved and when he is a member of either upper or middle class. This finding stood in direct conflict with the position of most earlier studies that held to a multiracial class system for Brazil.

In summary, though Brazil represents one of the great racial democracies, far in advance of the United States, it falls short of the ultimate reaches—namely, in racial democracy in marriage.

Microfilm \$2.50; Xerox \$7.80. 168 pages.

SOCIOLOGY, PUBLIC WELFARE

FEDERAL GRANTS TO THE STATES FOR COMMUNITY MENTAL HEALTH SERVICES WITH SPECIAL REFERENCE TO SOME WESTERN STATES

(L. C. Card No. Mic 60-1311)

William Gilliam Hill, D.S.W. University of Southern California, 1960

Chairman: Professor Class

One of the provisions of the National Mental Health Act of 1946 was that of grants to the states for community mental health services. This study renders an account of the development of this program and inquires into what has been achieved.

The study is guided by several questions: (1) whether the states have been stimulated into developing programs, (2) whether the grant has been used to dictate to the states, (3) whether there is an association between the administrative location of the state mental health authority and the use of federal funds.

To answer these questions, an examination of the nation's experiences during the first ten years of the program is made. A detailed investigation is made in five Western states--Arizona, California, Nevada, Oregon, and Washington--major attention being given to California. The question of whether the location of the mental health authority affects the use of grants grows out of the fact that each state has a choice in designating its mental health officer. This question is confined to the five Western states.

Sources relied upon include official reports of the responsible federal agency and program reports of the Western states. Field interviews also were held.

Findings. (1) Expenditures for community mental health services by the states have expanded significantly with little federal increase. Because of this, it may be said that stimulating the states at a minimal expense to the federal government has occurred; however, significant gaps in level of services exist among the states. (2) The assertion that the grant device is used to dictate to the states is refuted. This is due primarily to program variations existing among the states. (3) In Arizona, Nevada, Oregon, and Washington, the state health officers are the mental health authorities; California uses a department of mental hygiene. Evidence points to the consistent use of federal funds for children's services by Arizona, Nevada, Oregon, and Washington; in California federal funds have not been used for one particular group. (4) The most heavily populated states, with one exception, have as their mental health authority someone other than the state health officer.

Implications. (1) If federal grants should assure a minimum program of service to all, certain changes could be effected. These could include increasing the federal appropriation and changing the present method of disbursement of funds. (2) Whether or not the finding concerning the use of federal funds will hold in other states is not known. If it does, it would appear that a change in current policy is indicated, since the bill is for all and not for one group. (3) The fact that the most heavily populated states depend upon some agency other than the state health authority suggests that principles of administration have played a role. One could expect that as programs and population expand in other states, similar organizational rearrangements could occur.

The accomplishments cannot be undervalued. Within a span of ten years every state has developed a program of community mental health services, whereas in 1940 only one state had such a program. For all practical purposes the federal grant has facilitated this development.

Microfilm \$4.35; Xerox \$15.30. 339 pages.

SOCIOLOGY, RACE QUESTION

RACIAL DEMOCRACY IN MARRIAGE:
A SOCIOLOGICAL ANALYSIS OF NEGRO-WHITE
INTERMARRIAGE IN BRAZILIAN CULTURE.

(L. C. Card No. Mic 59-6560)

Austin John Staley, O.S.B., Ph.D. University of Pittsburgh, 1959

Please see abstract on page 4455.
Microfilm \$2.50; Xerox \$7.80. 168 pages.

THE PHILIPPINE CHINESE: A CULTURAL HISTORY OF A MARGINAL TRADING COMMUNITY.

(L. C. Card No. Mic 60-886)

George Henry Weightman, Ph.D. Cornell University, 1959

This study investigates the Chinese community in the Philippines. While not as numerous as their compatriots in some other countries of Southeast Asia, the Philippine Chinese have occupied a key position in the Islands since the early Spanish period. It is estimated that "ethnic Chinese", who number approximately 300,000 and constitute less than two percent of the Islands' total population, control more than one-third of the total trade of the country and at least seventy-five percent of the retail trade. There are few parts of the Philippines without Chinese retail traders or merchants, and it is in this capacity that they have come into intimate contact with the local population. The economic aspects of this marginal Chinese enclave in the Philippines have hardly been studied; the social consequences of their presence until quite recently have been almost completely neglected.

The study tries to demonstrate how the basic social institutions of a marginal trading community have been adapted to a new and basically hostile environment. In focusing on this problem area, the study considers the related questions of (1) the nature of the community in the past and the influence of Spanish and American colonialism upon it; (2) the particular nature of assimilation of an alien marginal trading community and the extent to which its assimilation was achieved in the past; (3) the state of present Sino-Philippine tensions. Although primarily sociological in orientation, considerable attention is given to the historic genesis of the community and its present politico-economic situation.

In gathering the data various forms of research tools were utilized. These include the use of available historic and governmental records, a survey questionnaire, directed and non-directed interviewing, and observational field work spanning a four-year period of residence in the Philippines. Throughout the presentation, the approach is that of a cultural history.

The Philippine Chinese community is defined to include all "ethnic Chinese", i.e., all who regard themselves or who are regarded by others as Chinese. Thus, the community includes some "naturalized" Filipinos as well as any Chinese mestizos ("mixed bloods") who are oriented toward Chinese culture. While formerly readily absorbed

into the larger Filipino community, the mestizos, partly through the implementation of recent Philippine legislative and administrative decisions but also through the operations of the Chinese school system, are increasingly being oriented toward the Chinese community. At present neither the Chinese nor the Filipinos actually seem to desire the assimilation of the alien community. While the evidence tends to support the view that inter-communal tensions are on the increase, an attitude survey of a Filipino sample presents a picture of "differentiated prejudice" where extreme cultural antipathy is not found to be in conflict with willingness to intermarry. Within the Chinese

community itself, the extended family, the sib, and even the phratry are shown to be of crucial social and political importance. Intra-communal tensions are seen often as a product of personal and sib rivalries traceable to incidents attending the downfall of the old imperial system and the establishment of the formal socio-economic institutional agencies of the Philippine Chinese. In conclusion, the study discusses the implications of its findings with respect to the understanding of the overseas Chinese elsewhere in Southeast Asia, and its relevancy to sociological research in the areas of race relations, assimilation, and role theory. Microfilm \$6.10; Xerox \$21.60. 478 pages.

SPEECH-THEATER

AN INVESTIGATION OF THE EFFECTS OF FREQUENCY DISTORTION UPON THE INTELLIGIBILITY OF MONOSYLLABIC WORD LISTS AND A SAMPLE OF CONTINUOUS DISCOURSE

(L. C. Card No. Mic 60-1329)

Thomas G. Giolas, Ph.D. University of Pittsburgh, 1959

This study was undertaken to investigate the relationship between monosyllabic word lists commonly employed to measure auditory discrimination ability and a sample of continuous discourse.

Specific lists from the PB 50 and W-22 Monosyllabic Word Lists were used for this comparison. One list from each series was presented in its commercially available form, and compared to new recordings of comparable lists from each series, which were made by using a single talker and controlling the monitoring procedure and recording conditions. The sample of continuous discourse employed was a fifteen-minute lecture.

The four word lists and the sample of continuous discourse were recorded on magnetic tape under seven filtering conditions of distortion achieved by various degrees of high frequency filtering. One hundred seventy-five normally hearing college students were employed as listeners. The subjects were divided into seven groups of 25, each group listening to all speech samples under one particular condition of distortion. The tests were presented at a level of intensity sufficient to yield maximum intelligibility scores.

The word lists were scored in terms of number of items correct, and the continuous discourse in terms of number of items correct on the test covering information presented in the lecture.

The following basic conclusions were made:

- Consistently higher intelligibility scores were achieved with the Hirsh recordings of the W-22 word lists under all conditions of distortion than with the Hughes recordings of the PB 50 word lists.
- 2. When the influence of dissimilar recordings was eliminated, consistently higher scores were again obtained on the W-22 lists than on the PB 50 lists,

- and such score differences were attributed to list content differences.
- 3. In addition to list content, the differences usually obtained between the scores on the Hughes and Hirsh recordings must be attributed, in part, to the monitoring procedure and poor fidelity of the Hughes sixteen-inch discs.
- Monosyllabic word lists as well as continuous discourse are affected in the same way by frequency distortion, i.e., errors increase as distortion increases.
- The effect of frequency distortion on the Hughes and Hirsh recordings is quite dissimilar. They differ in terms of overall errors, as well as error increase from distortion condition to distortion condition.
- Similar results were not found between the PB 50 and W-22 lists when the effect of dissimilar recording was eliminated. The error pattern differed only in degree.
- List differences, whether or not fidelity is considered, become greater as more distortion is introduced.
- No accurate intelligibility score prediction for the continuous discourse may be made on the basis of scores obtained on the PB 50 and W-22 word lists.
- 9. Increased distortion resulted in a much steeper slope for word lists than for continuous discourse.
- 10. Social Adequacy Indices computed with scores obtained on the Hughes or Hirsh recordings are an exaggerated estimate of the difficulty encountered in understanding continuous discourse, although the Hirsh recordings appear to produce a more realistic measure.
- 11. The error curves for the W-22 lists lie closer to the curve for continuous discourse than do the curves for the PB 50 word lists. List content is offered as a possible explanation for these differences.

12. The possibility of devising two phonetically balanced word lists differing in content as to word familiarity is offered as an approach for diagnostic and prognostic measures in clinical audiology.

Microfilm \$2.50; Xerox \$5.40. 107 pages.

THE RELATION OF DRAMATIC STRUCTURE TO THE IDEAS IN ROBERT E. SHERWOOD'S DRAMATIC WORKS

(L. C. Card No. Mic 60-1360)

Paul Charles Harris, Jr., Ph.D. Stanford University, 1960

Although Robert E. Sherwood was admired and respected by colleagues and the general public, a survey of secondary sources indicated there was no full length study of the subject's play-writing career.

The writer investigated what the author had written about himself -- as in the prefaces to his plays -- to gain an insight into his beliefs. There is only limited satisfaction in depending on what one learns from the author's prefaces, for there can be an appreciable difference between what a writer says about himself and his ideas and what actually emerges from his dramatic works.

The investigator decided to examine the thought found in these plays in order to discover whether a thematic pattern arose from theme; consequently, it was the writer's intention to learn what the plays as a whole said by analyzing Sherwood's manipulation of the structural elements of drama.

For the purposes of this study, the investigator distinguished, by definition, between thought and theme. The reader must not gain the impression that these words may be used interchangeably in this dissertation.

First, the writer states what he believes to be the theme of the play; then he submits evidence to support his contention. The methodology includes the analysis of the six parts of the drama; the elements of plot, character, and thought are discussed interdependently; dialogue, melody, and spectacle are treated subordinately.

At appropriate times, the examiner discusses the development and changes of the playwright's style and thought throughout his career. At the end of each chapter a subordinate conclusion sums up the findings to date.

The chronological examination of the author's dramatic works reveals an organic evolution of thought, discovers the basic ideas which arise from this revelation, and finally, suggests the meaning of the total findings.

This writer believes that two major themes emerge from Sherwood's plays. First, in his "early" and "middle" plays anti-war pacifist thought is reflected; gradually this thought changes to a plea for active military participation in his "mature" plays. Secondly, there arises from the total analyses of Sherwood's major plays another dominant theme: when man commits himself to a selfless act, which is a dramatic manifestation of his essential goodness, then he is justifying his existence; in effect, the author's plays dramatize his romantic liberal beliefs.

Finally, the examiner estimates the quality of the thought found in Sherwood's plays and, on the basis of that thought in relation to the total effectiveness of the plays,

concludes that Robert Sherwood should be considered as a major American dramatist of the first half of the twentieth century. Microfilm \$4.20; Xerox \$14.85. 327 pages.

AN INVESTIGATION OF THE MOST COMFORTABLE LISTENING LEVELS FOR SPEECH

(L. C. Card No. Mic 60-1493)

James Francis Kavanagh, Ph.D. The University of Wisconsin, 1960

Supervisor: Professor John V. Irwin

Statement of the Problem

Four questions served as an outline for this experiment. What are the relationships of: (a) the speech reception thresholds (SRT's) to the most comfortable listening levels (MCL); (b) the ascending to the descending MCL levels; (c) the listeners to their MCL levels; (d) the samples of speech to the MCL levels?

Procedure

The subjects in the experiment, all of whom passed a hearing screening test at 15 db, were divided into six groups: (a) 45 college men, (b) 37 college women, (c) 22 girls, (d) 20 mothers of the girls, (e) 29 boys, (f) 29 mothers of the boys. All of the subjects were required to select their MCL levels for ten different samples of speech. These speech samples were randomly presented with both ascending and descending loudness. A list of spondee words similar to that which was recorded by a male speaker and presented to all of the listeners, was recorded by an adult female and presented to the college men and women. The SRT's for these students were also established.

Results and Conclusions

The results of this study were presented as answers to the four questions given in the Statement of the Problem.

- (a) For the subjects tested, the correlations between the MCL levels and the SRT's clustered around zero.
- (b) The descending presentation of the ten recorded speech samples resulted in higher mean MCL levels than the ascending.
- (c) The adult males chose the highest MCL levels for speech while the female children chose the lowest. The adults had higher mean MCL levels than the children. It was also found that the mothers of the children had higher mean MCL levels than did their children. Individual variation in the MCL levels for the ten speech samples extended from 24.0 db to 36.5 db for the ascending and 27.5 db to 49.0 db for the descending presentations. Even wider individual variations were noted when the lowest choice of MCL level for one speech sample was compared with the highest. Under these conditions it was found that for the ascending presentation the difference in individual choices extended from 45 db to 60 db while for the descending presentation the difference ranged from 45 db to 65 db.
- (d) The MCL levels chosen by the college men and women were not greatly influenced by the use of a male or female voice. The mean ascending MCL level chosen by the 82 subjects was 1.89 db higher for the recorded male

voice than the female, and the mean descending MCL level chosen by the same subjects was 1.10 db higher for the recorded female voice than the male. Larger differences in the MCL levels were found, however, when the content of the speech samples was varied. These differences were as much as 9.51 db between two specific speech samples for the ascending presentation, and 9.25 db for the descending presentation, for the same speech samples.

Microfilm \$2.50; Xerox \$7.40. 156 pages.

WILBERFORCE'S SPEECHES ON THE ABOLITION OF THE SLAVE TRADE

(L. C. Card No. Mic 59-6387)

Hazel McDaniel-Teabeau, Ph.D. University of Missouri, 1959

Supervisor: Loren D. Reid

For forty-five years, 1780-1825, William Wilberforce was a distinguished member of the House of Commons. A defender of the Constitution and the Established Church, he was a reformer, philanthropist, humanitarian. Probably his greatest gift to posterity was his twenty-year struggle to abolish the British slave trade. Its successful resolution symbolized the power of the spoken word in solving one of the world's most controversial social problems. This study attempts to investigate Wilberforce's means of persuasion, and to discover the historical, political, and social forces that produced him, his speeches, and his audience.

As far as this investigator has been able to ascertain, no rhetorical studies of Wilberforce's speeches have been published. The critic must rely upon generalizations, scattered and isolated comments recorded in letters, memoirs, magazines, newspapers, and pamphlets; opinions expressed by parliamentary speakers during the debates, occasional interpolations by parliamentary reporters, and impressions of other persons who heard Wilberforce in the abolition debates.

The chief source of biographical material is The Life of William Wilberforce in five volumes (1838) by two of Wilberforce's sons, Robert Isaac and Samuel. It includes his diary, journal, and other memoranda which supply clues to his speech-making, hints of his method of speech preparation, background notes for his speeches; comments on friends; politics, his social, religious, and domestic life; and titles of books and other reading that engaged his attention. The diary also records Wilberforce's impressions of many contemporary speakers and occasional critical judgments of his own speech performance. From these materials has evolved Wilberforce's theory of rhetoric.

The texts of his speeches used in this study are Hansard's Parliamentary History and Hansard's Parliamentary Debates. For background materials on the slave trade, the principal source is Thomas Clarkson's The History of the Rise, Progress, and Accomplishment of the Abolition of the African Slave Trade by the British Parliament (1818) in two volumes. For West Indian background, the chief sources are Bryan Edwards' The History Civil and Commercial of the British West Indies (1819) and Thomas Southey's Chronological History of the West Indies (1827).

The Journals of the House of Commons have been explored for arguments for and against the abolition of the slave trade, contained in the many petitions to the House of Commons.

This study consists of fifteen chapters. Early chapters include the probable influences in Wilberforce's development as a speaker: his early home life and schooling, his studies at St. John's, Cambridge, his social life and politics as member for Hull, 1780-1784, and his parliamentary years as member for Yorkshire, 1784-1787. Also included are a discussion of Wilberforce's important speeches in support of Pitt's measures, Wilberforce's religious conversion, his resolution for self-improvement, his organizing the Society for the Reformation of Manners, and an appraisal of his Parliamentary years, 1780-1787.

Later chapters tell of the background of the abolition of the slave trade, preparation for the first attack upon the trade, and Wilberforce's preparation for the first abolition debate. The principal part of this study is an analysis of four of Wilberforce's major abolition speeches in four chapters: the speech of May 12, 1789; April 18, 1791; April 2, 1792; and May 30, 1804. Another chapter gives the status of the question from 1804 to 1807, and discusses the final abolition of the slave trade. The remaining chapters discuss Wilberforce's style, his delivery, his theory of rhetoric, and his effectiveness as a speaker.

Although the slave trade and slavery are theoretically dead, they have survived in various forms. The hunger for freedom and the struggle to attain it are universal. Universal too is the need for good men in the deliberative assemblies of the world to speak the language of humanity and social justice. Wilberforce was such a man. Largely through his speaking, he needs to be re-discovered. On this basis, we need to know more of his effectiveness as a speaker and parliamentary leader for the abolition of the British slave trade.

Microfilm \$4.90; Xerox \$17.35. 383 pages.

THE DEVELOPMENT IN AMERICA OF THEORIES OF DIRECTING AS FOUND IN AMERICAN WRITINGS, 1914-1930.

(L. C. Card No. Mic 60-1563)

Charles Leo Metten, Ph.D. State University of Iowa, 1960

Chairman: Associate Professor Oscar G. Brockett

It was the general purpose of this study to examine directorial theories found in American writings, 1914-1930, in order to trace their development. Within this general purpose, the study attempted to answer the following questions: (1) What specific directorial theories are indicated by the writings on directing, 1914 to 1930? (2) Who was responsible in America for the formulation of these theories and when was this done? (3) Is there a discernible pattern in the development of these theories? (4) How were these theories disseminated?

The following methodology was used: a bibliography was assembled which aimed at covering all American items published on directing from 1914 to 1930. The items of the bibliography were read, directorial theories isolated, and then analyzed.

Chapter I provides a brief historical background, discussing the major directorial theories that originated in Europe before World War I.

Chapter II discusses the development of the directorial theories of Americans considered as primary theorists by this study. The primary theorists are: Sheldon Cheney, Maurice Browne, Cloyd Head and Mary Gavin, Eugene Walter, Minnie Maddern Fiske, Arthur Hopkins, David Belasco, Robert Edmond Jones, Roy Mitchell and Stark Young.

In Chapter III, the development of the directorial theories of secondary theorists is discussed. Those considered as secondary theorists by this study are: Hiram K. Moderwell, Walter Prichard Eaton, Clayton Hamilton, Thomas H. Dickinson, A. M. Drummond, Stephen Allard, Arthur Krows, Emerson Taylor, John Corbin, Ira Hards, Montrose Moses, Barrett H. Clark, Kenneth Macgowan, Norman-Bel Geddes, George Pierce Baker, Clarence Stratton, Oliver Sayler, Lee Simonson, Harrison Fiske, Robert Milton, A. B. Williamson, Laura Whitmire, Harry Andrews and Bruce Weirick, Milton Smith, Allen Crafton and Jessica Royer, Gilbert Seldes, Frank Byers, Frank Williams, John Dolman, Halliam Bosworth, and Philip Moeller.

Chapter IV discusses the development of directorial theories in America in terms of the spread of the theories into popular thought by 1930.

Chapter V is devoted to a summary and conclusion.

The writings disclosed that theories of directing published by Americans during the years 1914-1930 were mainly concerned with the following general ideas: unity in production, movement on the stage, a play is action, the director's relationship to the actor, simplicity and suggestion in all elements of production, one guiding mind over a production, stage lighting, and unselfish devotion on the part of the theatre workers for a production.

The answers to the major questions proposed by this study are presented in Chapter V. The answer to questions one and two is given by listing chronologically first the primary theorists and their central ideas, and then the secondary theorists and their central ideas.

In answer to the third question, the study maintains that there was a discernible pattern of development in the theories of both primary and secondary writers. The development was the same in both cases, but with a change in emphasis occurring in the writings of the secondary theorists as the period progressed.

The answer to the fourth question is that theories of directing during the years 1914-1930 were disseminated primarily through books, newspapers, and periodicals. Of the three, periodicals not only did the most to spread the new ideas, but also reflected the popularization of

Appendix A presents an outline of the development of directorial theories of primary theorists according to the major ideas, i.e., unity in production, movement on the stage, etc. Appendix B outlines the practical theories of directing as found in the books on play production written by secondary theorists. Appendix C presents an annotated listing of books and articles specifically written about directing in America from 1914 to 1930.

Microfilm \$3.95; Xerox \$13.95. 307 pages.

EVIDENCES OF POPULAR SUPPORT FOR THE LAND-GRANT COLLEGE ACT OF 1862 AS REVEALED IN SELECTED SPEECHES IN NEW ENGLAND, 1850-1860.

(L. C. Card No. Mic 60-1370)

Kenneth Woods Pauli, Ph.D. Stanford University, 1960

This study has investigated one hundred and sixty-nine speeches delivered at agricultural fairs to New England farmer audiences in the decade prior to the passage of the Land-Grant College Act. It has attempted to learn from these speeches, first, whether the Land-Grant College Act had rural support; and second, other prevailing attitudes among farmers toward higher education.

Method of Study

A century ago agricultural fairs both expressed and formed rural opinion. A high point of each fair was the address delivered by a distinguished visiting speaker. These addresses provide an index of audience opinion because, as one scholar noted, they bear "the impress of the popular mind."

The writer found the speeches in the published transactions of state and county agricultural associations in New England. The area seemed to be especially desirable for study because of its high literacy, its relatively high interest in both agriculture and education, its distinguished leadership in both areas, and the favorable voting record of its representatives in Congress on bills relating to them.

Summary of Findings

Views of the Speakers

- Two-thirds of the speakers urged the need for agricultural education. Only one declared against it.
- 2. Fifty-five dealt at length with education. Twelve advocated that the existing colleges add agricultural courses, but eleven opposed that plan. Twenty-one thought that agricultural schools offered farmers a positive advantage, but five did not. Four spoke in behalf of a teacher-lecturer system. Seventeen believed that experimental farms should be established.
- 3. One of every four expressed concern about soil deterioration.
- 4. Twenty-eight spoke in behalf of book-farming; one denounced it.
- Of the twenty-eight who approved of book-farming, twenty argued that it would increase production and prevent soil impairment.
- 6. Eighty-eight proclaimed the value of science.
- Eighty-six discussed the problem of farmer status, but only one in six of this number seemed satisfied with it.

Views of the Audiences:

1. New England farmers had developed anxieties about their economic situation, the prestige of farming, and the sufficiency of their knowledge of agriculture.

- 2. They applauded the practical but disdained bookfarming and scientific farming.
- By and large they did not believe that they could be helped by formal education in agriculture regardless of how organized.
- 4. The problem of their social status seemed more important to them than any other.

Conclusions

The above itemization includes the findings of this study which bear upon one of the two problems under investigation, namely, the attitudes toward higher education prevailing among New England farmers during the 1850-60 decade. It also includes findings relating to the other and more primary question, to wit, whether support existed for the Land-Grant College Act among the same group of farmers.

The answer to this latter question is both negative and positive. On the one hand New England farmer audiences appeared little interested in the establishment of any kind of formal agricultural eduction; but on the other hand it must be emphasized that their concern for improving their group prestige undoubtedly inclined them to favor the passage of the Act. Although nothing in the record permits a wholly positive answer to the question, it may be reasonably conjectured that speakers were reflecting a firm audience belief when they observed, as often they did, that education would endow farmers with commanding dignity. Little doubt seems possible, therefore, about the interest . if not concern of farmers in regaining the esteem that as a class they generally recognized that they had lost. It seems highly probable that some of them saw in the Land-Grant College Act a possible bridge over their difficulties, a bridge to better lives for themselves and their families. Microfilm \$3.00; Xerox \$10.60. 232 pages.

RALPH WALDO EMERSON AS A PUBLIC SPEAKER

(L. C. Card No. Mic 60-1371)

Ralph Stanley Pomeroy, Ph.D. Stanford University, 1960

This investigation attempts to determine why Emerson's contemporaries considered him an outstanding speaker. It centers upon available audience criticisms of twenty speeches. Through an analysis of these criticisms, it seeks to discover Emerson's characteristic modes of oral appeal and to arrive at an appraisal of his speaking abilities.

Now, less than a century after his death, Emerson's contributions to American letters and the development of democratic thought generally are regarded as unique, significant, and lasting. His life, work, and influence have been widely discussed and variously interpreted. Nevertheless, no adequate study of his contemporary reputation as a speaker exists, even though his speech contributions receive incidental treatment in some biographical and critical studies. Available testimony indicates that Emerson's contemporaries held predominantly favorable opinions regarding his abilities and achievements as a speaker.

What were their probable standards of speech appraisal? Would such standards, applied to Emerson's speaking, be likely to lead to a responsible critical estimate? To what extent did his characteristic modes of oral appeal predispose his audiences toward accepting his ideas? These and related questions form the problem area with which this investigation deals.

In attempting to determine why Emerson's contemporaries considered him an outstanding speaker, this investigation proceeds as follows:

Chapter I, the introduction, presents a brief sketch of Emerson's life, a discussion of his rhetorical background and training, and a description of the criteria used in selecting the speeches to be analyzed.

Chapter II deals with Emerson's preaching. It presents a description of his typical sermon audiences, a discussion of his method of sermon preparation, and critical analyses of seven sermons. These include: "Pray Without Ceasing," "On Showing Piety at Home," "Summer," "A Feast of Remembrance," "The Ministry: A Year's Retrospect," "Trust Yourself," and "The Lord's Supper."

Chapter III deals with Emerson's lyceum lecturing. It presents a description of his typical lecture audiences, a discussion of his method of lecture preparation, and critical analyses of five lectures. These include: "Prudence," "Heroism," "Love," "The Conservative," and "The Young American."

Chapter IV deals with Emerson's epideictic speaking. It presents critical analyses of eight occasional addresses. These include: "Historical Discourse at Concord," "The American Scholar," "The Divinity School Address," "Literary Ethics," "Concord Address on the Fugitive Slave Law," "New York City Address on the Fugitive Slave Law," "Speech at the Celebration of the Burns Centenary," and "Abraham Lincoln: Remarks at the Funeral Services at Concord."

Chapter V, the conclusion, summarizes the findings and offers an appraisal of Emerson's speaking. From this appraisal it is concluded that Emerson's contemporaries considered him an outstanding speaker primarily (1) for his skill in invention, particularly his use of ethical proof, emotional proof, and argument by example; (2) for his versatility in style; and (3) for his fluency in delivery.

The appendix presents a chronological outline of Emerson's speaking from 1826 to 1881.

Microfilm \$4.40; Xerox \$15.55. 342 pages.

DEVICES AND FEINTES OF THE MEDIEVAL RELIGIOUS THEATRE IN ENGLAND AND FRANCE

(L. C. Card No. Mic 60-1381)

William Donald Young, Ph.D. Stanford University, 1960

The supernatural and miraculous subject matter of the medieval religious plays called for theatrical deception. The literal-minded approach to the staging of the mystery and miracle plays established a series of devices and feintes, as the French so precisely called them, which form a distinct production category. This dissertation is a study of these elements of the spectacle, the stage

tricks which employed special artificial means to represent events, either miraculous or otherwise difficult to reproduce.

The purpose of the study is to add to our conception of the medieval religious theatre by discovering what devices were used and how they were executed. The sources from which the author has drawn are three: original stage directions from the plays, expense accounts and property lists of the performances, and contemporary allusions to the productions.

The dissertation is divided into eight chapters. The first is an introduction in which are discussed and defined various preliminary matters, including the subject and its limits, the sources of information, and previous related studies.

The second chapter deals with liturgical performances in the churches. Here church properties such as candles, the corona, and the <u>sepulchrum</u> of the altar were first used both as symbolic and as representational elements of spectacle. These were the rudimentary forms of the later devices for the light of Heaven, the nativity star, the trap doors, and many other <u>feintes</u> widely used in the mysteries and miracles.

In the next five chapters these feintes are categorized and studied. Chapter III treats of light and fire. The symbolic presentation of the light of Heaven was effected by gilded costumes and painted faces and by candles and flaming swords. But fire devices in their many forms were primarily the property of Hell and the devils. References to the frequent use of fire in both France and England are numerous, and there exist many indications of a great variety of flammable ingredients.

Flying machines are the subject of Chapter IV. There is sufficient evidence to conclude that these devices were seldom more than a platform or harness with a system of ropes and pulleys by which an actor might ascend or descend between the Heaven and the world below. Fake clouds were often a part of these feintes, which were the forerunners of the cloud machines of the Renaissance stage.

The movable jaws of Hell, burial traps, sudden appearances, and passageways beneath the stage are discussed in the fifth chapter. This leads the investigation to consider the use of pits for water.

The subjects of Chapter VI are water, a variety of trick ships, and the numerous living and fake birds and animals that appeared in many scenes of the mystery plays.

In Chapter VII, which analyzes the <u>feintes</u> of blood and torture, are revealed some of the simplest devices for showing blood and some of the most complicated machinery for substituting dummies for actors in torture scenes.

The eighth chapter is a conclusion which reviews what has been learned of the various types of <u>feintes</u> and their execution, and clarifies the motivations of symbolism and realism.

The devices and feintes often appeared as a curious mixture of the literal and the symbolic. They were theatrical conventions of spectacle which resulted from a realism of detail in performances of plays whose traditional subject matter had a definite symbolic character. Although the illusion of these stage tricks was not always strong, the spectacle was awesome, and the active spectacle of the religious theatre of the Middle Ages was largely provided by the feintes.

Microfilm \$3.40; Xerox \$11.95. 262 pages.

ZOOLOGY

COMPARATIVE BIOASSAY FOR QUALITATIVE AND QUANTITATIVE ANALYSIS OF INSECTICIDES AND ACARICIDES

(L. C. Card No. Mic 60-1512)

Sutharm Areekul, Ph.D. Washington State University, 1960

Supervisor: Dr. Robert F. Harwood

Attempts were made to establish comparative bioassay methods for qualitative and quantitative determination of twenty-four insecticides, and seven specific acaricides, using the pomace fly Drosophila melanogaster Meig., the rusty grain beetle Cryptolestes ferrugineus Stephens, the brine shrimp Artemia salina Leach, and a stored product mite Tyrophagus putrescentiae Schrank. Simple, inexpensive, and reproducible techniques of rearing and testing these four organisms under standardized conditions were developed. The standard dosage mortality regression lines of all test toxicants to all test organisms were tabulated as numerical formulae. The sensitivities and suitabilities of the organisms tested for bioassay based on LD_{50S} and slopes of dosage-response regression lines were compared.

A theoretical basis for the qualitative bioassay of pesticides was accomplished by setting up patterns of mortalities of all test organisms for each toxicant in response to the dosage causing 50 per cent mortality to each organism. The results revealed that trends of mortalities among the test organisms either specifically or generally indicated the kind of pesticides. Specific mortality trends exist for allethrin, Chlorthion, Dimite, methoxychlor, Mitox, schradan, Sevin, and TDE at all tested base dosages. The patterns of mortalities formed by DDT, malathion, parathion, TEPP, and toxaphene, possess their own characteristic trends of mortality for most basic organisms. These trends should permit the qualitative determination of these pesticides without difficulty.

Close relationships of mortality patterns are found between aldrin, chlordane, dieldrin, endrin, heptachlor, heptachlor epoxide, isodrin, lindane; and between demeton, Thimet, and Phosdrin. The precise determination of each one of these insecticides must be based on the entire pattern formed by every basic LD₅₀. The mortality pattern of all insecticides in the chlordane series, however, suggested a toxicant characteristic of the group to be present. The following toxicants cannot be separated by these four organisms when responses within the 95 per cent confidence interval are used: Diazinon from Dipterex;

Chlorobenzilate or Kelthane from Sulphenone; Aramite from ovex.

It is felt that in practical use, when the field sample size is usually limited, this method of analysis will be more successful for field residues of suspected content than those that contain complete unknowns. The difficulty of this method of determination may arise not only from closely related compounds like the chlordane series, but also from factors that cause toxicity to deviate from that of pure toxicants. Such factors include interfering substances from tissue extractives, metabolic products of toxicants, and contamination with other toxicants. In general, clean-up procedures will be required to remove interfering substances from the extractives in order to obtain the pesticide sufficiently isolated to be comparable to the pure toxicant. The effects of metabolic products may not change the trends of mortality beyond the trend of their parent compounds, as in the case of aldrin and dieldrin, but a complete change of mortality pattern due to metabolites can be expected from systemic insecticides.

Although pomace flies appear best for the quantitative bioassay of most insecticides, other tested organisms can serve to confirm the results of analysis. Only the mite and brine shrimp are suitably sensitive, and produce sufficiently steep slopes, to indicate their use for the assay of the specific acaricides, Aramite, Chlorobenzilate, Dimite, Kelthane, Mitox, ovex, and Sulphenone.

Microfilm \$2.50; Xerox \$5.60. 111 pages.

THE EFFECT OF DIFFERENT LEVELS OF INORGANIC PHOSPHORUS IN THE GROWING MEDIUM ON THE ABSORPTION, TRANSLOCATION AND DETOXIFICATION OF SYSTOX AND THIMET IN LIMA BEAN PLANTS.

(L. C. Card No. Mic 60-1422)

Robert Vincent Bielarski, Ph.D. Rutgers University, 1960

Major Professor: Dr. Clyde C. Hamilton

It was found that the amount of inorganic phosphorus in the growing medium affected the absorption and translocation of Systox and Thimet by lima bean plants from the medium. Increasing the amounts of inorganic phosphorus in the growing medium decreased the amount of Systox and Thimet absorbed by the roots and translocated to the foliage. It was assumed that the absorption and translocation of Systox and Thimet are related to the phosphorus level of the plant rather than the phosphorus level of the growing medium.

Systox and Thimet had no effect on the oxygen consumption of lima bean leaves, regardless of the inorganic phosphorus level, except for a slight decrease in the plants grown in the low phosphorus sand and treated with Systox.

There was more Systox and Thimet detoxified in plants grown in high phosphorus sand than there was in low phosphorus sand. Detoxification of Systox or Thimet in plants of the same inorganic phosphorus level proceeds at a definite rate regardless of the amount applied. The more Systox and Thimet applied initially, the longer will be the effectiveness.

The phosphorus level of the plant had less effect on the rate of absorption of Systox and Thimet through the foliage than through the roots. At two concentrations of Systox and one concentration of Thimet applied to plants in low phosphorus sand, there was an increase in the amounts absorbed.

Plants grown in low phosphorus nutrient solutions absorbed more solution than plants grown in high phosphorus nutrient solutions, and when Systox and Thimetwere added to the nutrient solutions there was a decrease in the volume absorbed.

Microfilm \$2.50; Xerox \$5.00. 98 pages.

THE INFLUENCE OF ANDROGEN ON PROTEIN METABOLISM OF NORMAL AND TUMOR BEARING RATS

(L. C. Card No. Mic 60-1426)

Paul Fredrick Brande, Ph.D. Rutgers University, 1960

Major Professor: Dr. James Leathem

Nitrogen retention in adult male Long-Evans rats was determined over 20 days with and without testosterone with dietary proteins consisting of 18% casein, lactal-bumin, wheat gluten or gelatin. Food intake was restricted to 100 calories per kilogram rat weight. Nitrogen balance of 3200, 1800, 4000 and 1000 mg. per kilogram was observed in animals fed casein, wheat gluten, gelatin, and lactalbumin respectively. The nutritional variation did not induce changes in tissue protein levels which could be correlated with nitrogen balance.

To appraise the anabolic potential of testosterone propionate, it was observed that nitrogen balance of rats treated with the hormone was increased when lactalbumin or wheat gluten was fed, but was unaffected by the androgen in animals fed casein. Hormone treatment lowered nitrogen balance in animals fed gelatin. Relative kidney size and protein was increased by the androgen in casein fed animals but heart protein concentration was reduced in hormone treated animals fed casein or lactalbumin. Heart and gastrocnemius muscle protein concentration was significantly less in hormone treated animals fed lactalbumin than in hormone treated animals fed casein, wheat gluten or gelatin.

Presence of a sarcoma (RU-1) did not markedly alter the nitrogen balance from that seen in non-tumor animals when casein or lactalbumin served as the dietary protein. Tumor bearing animals fed wheat gluten exhibited an increase in total retained nitrogen, whereas the nitrogen balance of animals fed gelatin was markedly lowered by the tumor. Liver hypertrophy and increased water content was observed in tumor animals regardless of the dietary protein, but an increase in liver protein concentration was seen only in casein fed animals.

The increased nitrogen balance in response to testosterone propionate in animals fed lactalbumin was not altered by the sarcoma. Wheat gluten fed rats also maintained the androgen induced nitrogen retention but to a lesser degree than in non-tumor animals. The androgen was without effect on the nitrogen balance of animals fed gelatin, but exhibited an adverse effect in casein fed rats.

Total kidney protein was increased by the hormone when casein or gelatin was fed. When compared with non-tumor animals, tumor bearing hormone treated rats fed lactal-bumin exhibited an increased heart and gastrocnemius muscle protein concentration in spite of a decreased organ size.

Adrenal size was increased by the tumor in animals fed casein, wheat gluten or gelatin and was not altered by the androgen. Testosterone propionate did not alter the enlarged spleen observed in tumor bearing animals. The seminal vesicle of tumor bearing animals was reduced in size but did not respond to testosterone propionate.

Microfilm \$2.50; Xerox \$6.80. 143 pages.

ECOLOGY OF THE BOTTOM FAUNA OF PARVIN LAKE, COLORADO.

(L. C. Card No. Mic 58-1201)

Philip Augustus Buscemi, Ph.D. University of Colorado, 1957

Supervisor: Professor Robert W. Pennak

The benthic environment of Parvin Lake, Colorado, was studied from April 14, 1954, to July 10, 1955. Located at an altitude of 8,200 ft. in Larimer County, Colorado, this lake has a mean depth of 4.4 m., a shoreline development of 2.01, and is primarily a littoral and sublittoral habitat. Bottom water temperatures, oxygen concentration near the mud-water interface, organic and inorganic content of the bottom sediments, and the summer growth of Elodea canadensis were the ecological variables related to the bottom fauna populations. Most samples were taken along two transects, one located over the inlet bay with heavy plant growth, and the other over an open water area with little vegetation. Temperature records indicated that the lake is a transition between the second and third order lake types. A pronounced summer oxygen depletion developed in the near-bottom water of the inlet bay beneath the Elodea from June 17 to August 5. Winter stagnation failed to develop in the lake. Volatile matter of the bottom sediments varied from an average of 18.1 per cent in the inlet bay to 9.2 per cent in the open water. The large amount of volatile matter in the sediments below 8.5 m. supported only Lumbriculus, Tendipes, and Pisidium in limited numbers. It is thought that floating rafts of Elodea with their contained fauna contributed to the spotty distribution of the fauna in the sublittoral and profundal zones.

Although rather limited in species, the bottom fauna was found to be unusually high in numbers and weight. The mean 11-month (June, 1954, to April, 1955) standing crop within the 0 - 8.0 m. contour was estimated to be 99.8 kg per ha dry weight. Perhaps the most striking feature of the distribution pattern along the inlet bay transect was that very small numbers of animals were found a half-meter deeper than the pronounced concentration zone which developed at 1.0 m. Of the mean total number at this 1.5 m. depth, about 35 per cent were Lumbriculus and 47 per cent overwintering cocoons of Endochironomus. Oxygen depletion during the summer months beneath the Elodea reduced the total population in this area to less than 30 per cent of that at 1.0 m. The high concentration of bottom

fauna around the shoreward limit of heavy vegetation may have been caused by migration of organisms from under the plant mass during the summer months. The great majority of animals were found at depths of 1.0 m. and less along the open water transect, although a noticeable concentration zone was noted at 2.0 m. The reduced numbers at 1.5 m. may be accounted for by undercurrents which would tend to sweep the organisms down to greater depths or even into the shallows.

Seasonal variations of the littoral bottom fauna were not exceptional with perhaps the reservation that total numbers were lower in 1955 than in 1954. Factors which could be responsible for this trend would be predation by large numbers of yellow perch in 1954, the relatively severe 1954-55 winter, or a general reduction in lake productivity. There was a fall and winter maximum and a spring and summer minimum produced primarily by emergence and the summer growth of Elodea. On the basis of funnel trap collections, all of the Diptera in Parvin Lake had one-year life cycles and most were spring and summer emergent forms. Every type of nutrition was utilized, from facultative anaerobes and scavengers to plant and organic detritus-feeders. Excellent environmental conditions and a wide variety of ecological habitats were factors chiefly responsible for the high littoral and sublittoral populations in this mountain lake.

Microfilm \$2.50; Xerox \$8.00. 174 pages.

A STUDY OF FACTORS INFLUENCING RESISTANCE IN CORN HYBRIDS TO THE RICE WEEVIL, SITOPHILUS ORYZA (L.).

(L. C. Card No. Mic 60-1293)

Rajendra Kumar De, Ph.D. North Carolina State College, 1960

Supervisor: Walter Michael Kulash

An evaluation of the susceptibility and resistance to the rice weevil of nine corn hybrids and one open-pollinated variety of corn was made in 1957. The hybrids tested were the full-season hybrids, Dixie 18, Dixie 82, N. C. 27, Coker 811, Coker 911, and the open-pollinated variety Latham Double, and the short-season hybrids, N. C. 46, U. S. 523, Ohio C-54, and VPI 426.

Two of the short-season hybrids, VPI 426 and Ohio C-54, showed higher susceptibility to weevil attack than the others.

In 1957, a further evaluation of the same ten hybrids was made under conditions of artificial infestation with adult weevils in the laboratory. The increase in the per cent weevil infestation and the population was consistently higher in the hybrids VPI 426 and Ohio C-54 than in others.

An evaluation of these hybrids and the variety was also made as regards corn earworm damage in 1957. A significant intervarietal difference was found in the case of the early planting (April 11), but not in the late one (planted May 2). The variety, Latham Double, had more earworm damage than the nine hybrids in the early planting.

Tests in 1958 included five full-season hybrids tested in 1957: Dixie 18, Dixie 82, N. C. 27, Coker 811, Coker

911; and five other full-season hybrids, N. C. 288, Funk G-740, Coker 66, Coker 67, and Pioneer 309 B. No significant intervarietal difference was found as regards weevil infestation.

No significant intervarietal difference was found as regards earworm damage with the exception of Pioneer 309 B, which showed higher susceptibility than the others. The susceptibility was, however, not consistent.

An attempt was also made to explore factors which were supposed to be associated with the resistance of the corn against the rice weevils. No significant intervarietal difference in the per cent moisture content of the tips or basal parts of the corn ears was noticed. Correlation between the weevil infestation of corn ears in the field to corresponding per cent moisture content of the ears was found to be negatively significant in the case of two hybrids only in 1957 and none in 1958. No significant correlation was found between the per cent weevil infestation of shelled corn from early and late plantings and the corresponding moisture content in 1957.

In 1957, the susceptible hybrids were found to have a higher per cent of ears with naturally exposed tips than the resistant hybrids.

In 1958 markedly higher weevil infestation was recorded on corn ears as well as shelled corn from ears with artificially exposed tips than those without exposed tips. Rice weevils were more abundant on ears with earworm holes than on those without holes. A significant negative correlation between per cent infestation and per cent of ears without earworm holes was also found in two hybrids in 1958.

A number of factors were presumably associated with the resistance of corn to rice weevil attack in the field, of which the mechanical obstruction provided by husks was apparently the most important one. A factor or factors associated in some way with husked corn, probably with kernels, served also to play an important role.

Husked ears of Dixie 18, Dixie 82, N. C. 27, Coker 811, and Coker 911 were stored for nine months. Significant differences between some of the hybrids were noted during storage as regards weevil and Angoumois grain moth infestation and weight loss. Dixie 82 showed higher infestation and weight loss than the other hybrids.

An evaluation of these five hybrids was also made under controlled temperatures of 82° F (R.H. 45-55%), 70° F and 55° F (R.H. 55+2%) in shelled corn storage with artificial infestation with ten adult rice weevils and in field-infested shelled corn. No significant intervarietal difference as regards weevil infestation was noticed at any of the temperatures.

The effect of weekly spraying of corn plants after ear formation with DDT and malathion was evaluated. The chemical treatment was found to have a profound influence in reducing the infestation of rice weevils and Angoumois grain moth in storage.

Microfilm \$2.50; Xerox \$6.00. 122 pages.

NATURE OF CHEMICAL CHANGES OCCURRING IN RESIDUES OF MALATHION

(L. C. Card No. Mic 60-1268)

Abdel Rahman Mohamed El-Refai, Ph.D. Kansas State University, 1960

Tests were conducted to obtain information regarding the effect of controlled environmental factors, including ultraviolet light, relative humidity, wind velocity and high temperature on the quantity and nature of losses of malathion. By using a specially-constructed wind tunnel, these factors were controlled.

Four compounds which could be the breakdown products under these environmental factors, or metabolites in the biological systems, were synthesized according to the published procedures.

Three formulations containing malathion were employed to obtain residues on glass plates: (1) Carbon tetrachloride solution; (2) 95 per cent ethyl alcohol solution; and (3) emulsion consisting of 0.2 per cent of 1:1 mixture of triton B1956 and X155 dissolved in 50 per cent ethyl alcohol.

Comparison of malathion residues deposited by the above systems showed that the residue dissipation was uniform and significant in the absence of air movement at 29°C.

The corresponding per cent losses of malathion residues from glass plates and glass plates coated with alfalfa wax and subjected to some of the weather components were determined. It was shown that the plant wax had little or no effect in retaining the malathion residues. This condition prevailed for ultraviolet radiation, wind tunnel and high temperature.

Attempts were made to retard the dissipation of malathion residues by adding piperonyl butoxide, UV24 ultraviolet absorber and Plyac Spreader-Sticker. Only the UV24 ultraviolet absorber retarded the dissipation of malathion. Piperonyl butoxide actually increased the residue dissipation.

The effect of relative humidity was evaluated on a concentration of one mg. per 5 cm. X 10 cm. glass plates, at a wind velocity of 11.3 miles per hour at two temperatures, 29°C. and 43°C. Each experiment was replicated three times. A decrease in relative humidity was accompanied by an increase in the dissipation of malathion residues. The higher temperature (43°C.) promoted more rapid dissipation.

Three methods were employed to identify the residues found after exposure to ultraviolet radiation: (1) Paper chromatography; (2) cholinesterase inhibition test; and (3) absorption in the U.V. wavelengths.

Using chromatographic technique it was possible to detect the presence of the following breakdown compounds:
(a) 0,0-dimethyl hydrogen phosphorothioic acid; (b) 0,0-dimethyl hydrogen phosphorodithioic acid; and (c) 0,0-dimethyl-S-(1,2-biscarboxy)-ethyl phosphorodithioate.

Malathion and its oxygen analog, malaoxon, could be detected by the acetonitrile system but the reverse systems of paper chromatography were much better for identification and separation of malathion and malaoxon.

The examination of the residue in the U.V. wavelengths were made by using a Cary Model II recording spectrophotometer.

Using the in situ cholinesterase test, no spots for

malathion were observed, but spots with similar R_f values for malaoxon and the UV degradation product were observed.

The results of chemical analysis and in vitro anticholinesterase activity of malathion before and after exposure to ultraviolet light were measured. In vitro anticholinesterase activity increased at the same time that the malathion colorimetric method measurement greatly decreased. Also, the U.V. light increased the amount of products which partioned into polar solvent.

A modification of Norris-Averell colorimetric method of malathion was developed for determination of 0,0-dimethyl phosphorodithioic acid and the breakdown compounds which may be converted to dithioic acid. Pure malathion did not respond to this method while commercial malathion developed a yellow color indicating the presence of dithioic acid and possibly some other substances that interfere with the colorimetric method.

Microfilm \$2.50; Xerox \$3.80. 66 pages.

SOME BIOLOGICAL EFFECTS OF THE USE OF HEXADECANOL TO SUPPRESS EVAPORATION FROM RESERVOIRS

(L. C. Card No. Mic 59-5253)

Murray Lawrence Hayes, Ph.D. Colorado State University, 1959

Evaporation from the surfaces of reservoirs is a major cause of water loss. Chemical suppression of evaporative water-loss by the use of monomolecular layers of hexadecanol (cetyl alcohol) appears practicable at costs within economic limits. However, hexadecanol films used to suppress evaporation may cause fundamental changes in the chemical and physical conditions at the surface of the water. These changes may significantly affect the fauna and flora, cause changes in water quality, and influence the recreational use of reservoirs.

A study of some biological effects of the use of hexadecanol to suppress evaporation from reservoirs was conducted at Colorado State University from 15 December 1956 until 31 December 1958. These investigations were conducted in the Limnology Laboratory of the University and at seven gravel-pit ponds located near Fort Collins, Colorado. Four of these were treated with hexadecanol, and three were retained as untreated control ponds. Hexadecanol was applied by means of wire-mesh rafts and hand spreading. Application of the material to the treated ponds ranged from 0.118 to 0.930 pounds per acre per day. Film coverage on treated ponds varied inversely with wind force, but averaged about 33 percent as measured in midafternoon. In general, film coverage was complete only during dead calm periods, 30 to 100 percent complete with winds up to seven miles per hour, and less than 30 percent complete when winds exceeded seven miles per hour.

The application of hexadecanol to the experimental ponds caused no measurable change in dissolved mineral constituents, alkalinity, dissolved carbon dioxide, or hydrogen ion concentration when compared with waters from untreated ponds. However, hexadecanol caused a small decrease in the rate of diffusion of oxygen across the airwater interface in field and laboratory experiments.

The temperatures of the surface waters of ponds treated with hexadecanol averaged 2.6°F. and 3.8°F. warmer than those of untreated ponds in 1957 and 1958 respectively. The surface tension depression caused by a compressed film of hexadecanol was observed to be near 40 dynes per centimeter, whereas the surface tension depressions caused by natural films, on open waters near Fort Collins, were always less than five dynes per centimeter. Since the surface tension of clean water is near 72 dynes per centimeter, a hexadecanol monolayer reduces the strength of the surface film by more than 55 percent.

Hexadecanol caused no mortality among fish in laboratory aquaria which were fed a diet containing 50 percent hexadecanol for periods up to 91 days. Trout planted in a pond treated with hexadecanol showed the same growth at the end of a one-year period as those planted in an untreated pond. The numbers of immature aquatic insects living in the bottoms of treated ponds remained at levels near those prior to treatment with hexadecanol. However, emergence to the adult stage of certain midges, mayflies and mosquitos was hindered by changes in surface tension caused by the presence of a monolayer of hexadecanol. Most insects that occur as air-breathing adults in the water (Coleoptera and Hemiptera) appear to be unaffected by the presence of hexadecanol. However, large water striders were observed to fall through compressed films and drown. Hexadecanol flakes floating in water provide substrata for complex encrusting communities of plants and animals. Some of these animals and plants may metabolize hexadecanol and increase in relative numbers with its presence. Large numbers of aquatic invertebrates were found living within the rafts used to spread hexadecanol.

No detrimental effect of hexadecanol was noted on plankton or nekton. There were no obvious effects of hexadecanol noted on frogs, salamanders, muskrats, beaver, turtles, water snakes, shorebirds, or ducks.

Over-all, it might be said that most biological effects of hexadecanol are small in magnitude and well within the range of natural variation. However, one effect, that of surface tension reduction, is large. Members of the biota dependent upon support of the surface film at some stage in their life histories may be adversely affected.

Microfilm \$2.50; Xerox \$6.60. 136 pages.

AN IMMUNOCHEMICAL ANALYSIS OF LIMB REGENERATION IN THE ADULT NEWT, TRITURUS.

(L. C. Card No. Mic 60-374)

Hans Laufer, Ph.D. Cornell University, 1958

Immunochemical procedures were employed to analyze changes in proteins during limb regeneration in the adult newt, Triturus. Methods for the isolation of myosin and actomyosin were modified for use in the newt. Actomyosin was extracted in a solution of buffered KC1 and then precipitated by diluting the solution (method of Szent-Györgyi). Myosin was prepared according to the procedure of de Villafranca (1956). Both molecular species were further purified by repeated precipitation and extraction.

The products of newt muscle were then characterized biochemically; their adenosine triphosphatase and contractile activity, and their viscosity properties agreed with those of the standard muscle proteins taken from the rabbit.

These muscle proteins, which heretofore have eluded such analysis, were tested successfully by methods of agar diffusion. The presumably pure actomyosin, prepared according to Szent-Györgyi, was found actually to be contaminated by myosin and a second component, a nucleoprotein. The compounds in increasing order of their diffusion coefficients were actomyosin, myosin and nucleoprotein. The injection of myosin into rabbits elicited the formation of antibodies which when tested in agar diffusion demonstrated a minimum of one band, but on occasion two when contaminated by minor quantities of actomyosin.

Some modification of existing procedures are described for the use of small reagent samples in Ouchterlony plates and for semi-micro quantities with Oudin agar diffusion tests

The development of muscle during normal limb regeneration was tested by the immunochemical method of agar diffusion. Actomyosin and myosin are first detectable within the regenerate stage of hand formation ("palette" stage). Thereafter there is an upsurge of synthesis of these proteins during the early and moderate digital stages. The appearance of the antigenic muscle proteins probably coincided with the time of myofibril formation. A rise in nucleic acid protein preceded the appearance of muscle protein and later decreased to a concentration characteristic of adult tissues. All tissues which were tested immunologically contained the nucleoprotein component. Other tests on newt embryos in the yolk plug stage and possibly earlier seemed to contain muscle proteins or similar combining groups.

Infusions of rabbit serum and antimuscle serum into the regenerates yielded a cytotoxic response which varied according to the serum used, the reaction to the immune serum being more severe. There was a temporary cessation of regeneration of a few days, the extent being related to the severity of the reaction. Observations of the histopathology of infused regenerates revealed sarcolysis attributable to the specific effects of the antimuscle serum.

Autoradiograms of limbs infused with I¹³¹ antiactomyosin demonstrated the dispostion of labelled antibodies within the regenerate and stump. There was localization of antibodies in muscle cells. The epidermis appeared to be an active organ for the elimination of such foreign material.

Microfilm \$2.60; Xerox \$9.00. 197 pages.

SYSTEMATICS AND ZOOGEOGRAPHY OF PHILIPPINE SNAKES

(L. C. Card No. Mic 60-1367)

Alan Edward Leviton, Ph.D. Stanford University, 1960

More than 30 years have elapsed since Taylor's pioneer work, The snakes of the Philippine Islands, was published. The recent availability of larger samples of Philippine snakes has permitted a complete reevaluation of that fauna.

This study is divided into two parts. In the systematic

section, data obtained by the application of standard systematic techniques, and interpreted in the light of modern "population" concepts of species, has necessitated numerous taxonomic changes. Taylor recognized 86 species (100 species and subspecies) of Philippine terrestrial snakes. Sixty-five species (89 species and subspecies) are acknowledged here, including six species and subspecies described since Taylor's last publication on Philippine snakes (1928), two nominal subspecies which are here reinstated (Calliophis calligaster gemianulis [Peters] and Maticora intestinalis suluensis [Steindachner]), and one which is described herein as new. These species are placed in 28 nominal genera, four less than recognized by Taylor. In addition to incorporating many nomenclatural changes at the generic level proposed during recent years by others, I have introduced three new taxonomic modifications: Haplonodon = Lycodon, Liopeltis (part) = Gonglyosoma, and Stegonotus (part) = Lycodon.

The 89 recognized species and subspecies of Philippine snakes are treated in detail, including annotated synonymy, range, list of material examined, diagnosis, quotation of original description, supplemental descriptive notes (including description of the hemipenes), analysis of sexual dimorphism, analysis of inter-island variation, and ecological notes. All genera have been defined, and keys to the families, genera, species and subspecies of terrestrial

Philippine snakes have been given.

In the zoogeographic section, the distribution of Philippine snakes is discussed. Three genera are endemic to the Philippines. Cyclocorus and Hologerrhum are closely allied; they are not related to any genus known outside of the Philippines and probably originated in those islands. Oxyrhabdium, related to Xylophis, a genus restricted to the Western Ghats, India, is probably the oldest ophidian element in the Philippines. All other terrestrial Philippine snakes (68% of which are endemic species and subspecies) were derived from Malayan-western Indonesian faunal elements which entered the Philippines between Pliocene and Recent times.

The present distribution of Philippine snakes suggests dispersal through a continuous, favorable environment, at times when various islands were joined by subaerial land. In only a few instances is it necessary to postulate dispersal by fortuitous means.

Two invasion routes into the Philippines have been open to the snakes. Of these, the Palawan route allowed elements of the Bornean fauna to reach Palawan and the Calamianes islands. The Sulu route permitted Bornean snakes to enter the eastern Philippines. There are no eastern Indonesian, Papuan, or Formosan snakes in the Philippines which are not also found in Malaya and western Indonesia. Microfilm \$11.20; Xerox \$39.85. 885 pages.

A STUDY OF THE SARCOPHAGINAE OF WESTERN NORTH AMERICA: TAXONOMY OF THE FEMALES, AND A POSSIBLE APPROACH TO QUANTITATIVE CLASSIFICATION.

(L. C. Card No. Mic 60-1518)

Verne Frederic Newhouse, Ph.D. Washington State University, 1960

Supervisor: Dr. M. T. James

In view of the incomplete knowledge of the taxonomy, especially of the females, and phylogeny of the Sarcophaginae, an attempt has been made to describe, as fully as possible, the females of the western states available for study, and explore a possible method of simple quantitative determination of relationships.

One hundred and fifteen species are listed as occurring in the eleven western states. Of these, 71 were available for study of the gross anatomy and 56 of the 71 for the dissection and description of the external and, to some extent, internal female genitalia. The genital segments are illustrated in situ, as are the spermatheceae and accessory glands for all 56 species dissected. The structure and taxonomy of the female genitalia are briefly discussed and a key is presented for the 71 species described.

In an attempt to discover a method of expressing total anatomical characteristics quantitatively, divorced from the bias of direct observation, 148 general body characters and 39 genitalic ones were studied and converted into numerical values by the following method:

The character was weighted as its percentage of occurrence subtracted from 1.0, or

1 - number of flies displaying a character total number of flies = value

For example, character 55, the number of presutural intraalar bristles, exists in three states.

State 1, 1-0-1 or 1-1-0-1
$$1 - \frac{44}{71} = .381$$

State 2, 1-0-0 $1 - \frac{25}{71} = .648$
State 3, 1-1-1 $1 - \frac{2}{71} = .972$

In this way, all characters are weighted without bias. Those characters which occur uniformly throughout the group are valued relatively low numerically; those found only in a few cases are valued high.

Totaling the values for these characters provided a spread, but no grouping. It was found that by plotting the totals separately for head, thorax, etc., in the form of a histogram, adding the numbers of the position of each species as it falls from left to right in the several histograms, and plotting these totals on a graph with the "body" totals on the ordinate and the genitalic characters on the abscissa, a certain rough grouping occurred. It has not been possible quantitatively to further refine this grouping by this method.

By graphing the genitalia figures with the character number on the abscissa and the total values on the ordinate, and comparing the fit of these graphs by superposition, smaller groups and group comparisons have resulted. Unfortunately this method utilizes only a small part of the anatomy of the fly. The structure resulting from the graphing of body characteristics follows closely that derived from certain systems of taxonomy, in which such genera as Sarcophagula, Metoposarcophaga, and Wohlfahrtia are widely separated, and a large complex genus Sarcophaga sensu lato remains. In addition, comparisons between the genitalia graphs of the large Sarcophaga group produced a structure very similar to that followed by the more restricted generic divisions.

On the basis of this study, it seems that at present it might be best to retain the more complex genus Sarcophaga sensu lato, and that the more restrictive groupings may actually be below the generic level. The inability to form actual "structure" without the use of the genital characteristics, and the formation of species groups based only upon these characters indicates their relatively high importance to the taxonomy of the group. No phylogenetic indication was recognized, but undoubtedly a much greater segment of the world sarcophagid fauna must be studied, and considerable refinement of method is necessary before such will be evident.

Microfilm \$4.60; Xerox \$16.20. 357 pages.

A STUDY OF SOME MONOGENETIC TREMATODES FROM MARINE FISHES

(L. C. Card No. Mic 60-1535)

Edward Stanley Robinson, Ph.D. The University of Nebraska, 1960

Adviser: Harold Winfred Manter

Collections of monogenetic trematodes from marine fishes of New Zealand and Puget Sound, Washington were studied. Most of the New Zealand trematodes were collected by Dr. H. W. Manter in 1951. The author collected the Puget Sound material during the summer of 1958.

A new genus and species of the family Microbothriidae from Scymnodon plunketi (Waite), Plunket's shark, is described from New Zealand. Nine of the eleven other species reported from New Zealand are considered new:

Calicotyle sp. (family Monocotylidae) from Squalus lebruni, dogfish; Trochopus sp. (family Capsalidae) from Helicolenus percoides, sea perch; two Megalocotyle spp. (family Capsalidae) from Latris lineata, trumpeter; Encotyllabe sp. (family Capsalidae) from Chironemus spectabilis, red moki; Diclidophora sp. (family Diclidophoridae) from Coelorhynchus australis, rat fish; Microcotyle spp. (family Microcotylidae) from Longirostrum platessa, trevally, and Parapercis colias, blue cod; and Winkenthughesia sp. (family Gastrocotylidae) from Lepidopus caudatus, frost fish.

Two of the ten species reported from Puget Sound are considered new: Entobdella sp. (family Capsalidae) and Diclidophora sp. (family Diclidophoridae) both from Atheresthes stomias, long jawed flounder.

The following are new host records: Udonella caligorum Johnston, 1835 from Thyrsites atun, barracouta; Empruthotrema raiae (MacCallum, 1916) from Raja nasuta Muller and Henle, skate; and Prosomicrocotyla chiri (Goto, 1894) from Hexagrammos stelleri, white-spotted greenling.

The New Zealand fauna of Monogenea shows affinities with that of Australia, where related species occur on

related hosts. Only one species has been reported as yet from both Australia and New Zealand, but several genera are common to both regions. The Monogenea fauna of Puget Sound shows affinities with monogenetic trematodes of Japan and Europe.

Microfilm \$2.50; Xerox \$3.80. 70 pages.

A REGIONAL ANATOMY OF THE HEAD,
NECK, THORAX, AND ABDOMEN OF THE
CHINCHILLA, CHINCHILLA LANIGERA
LANIGERA BENNET, WITH SPECIAL REFERENCE
TO THE DIGESTIVE TRACT.

(L. C. Card No. Mic 58-5326)

Robert Kenneth Wolfer, Ph.D. Michigan State University, 1955

Supervisor: R. A. Fennell

Although the locomotor apparatus of rodents has been the subject of numerous investigations the gross anatomy of the digestive tract has been neglected. The present study represents an initial contribution to the detailed knowledge of the digestive system of the chinchilla, Chinchilla lanigera lanigera Bennet, a hystricomorph rodent.

Twenty-five adult animals were dissected and sixtyfour drawings made of various dissections. For topographical reasons, the major axially-placed organs of the other body systems have been illustrated and briefly described.

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The oral cavity presents a trichous post-incisal subdivision. The teeth are twenty in number, are monophyodont, and all erupt continuously. The tongue presents a wide variety of papillae. The pharynx is chiefly nasopharynx and a laryngeal pharynx is absent. The esophagus is not noticeably modified.

The stomach is relatively unsacculated. It is not possible to distinguish any definite subregions of the relatively small intestine. Numerous macroscopic lymphatic nodules are present in the wall.

The large intestine has an expanded spiralled and sacculated cecum, a long large colon and a long and highly coiled small colon. Whereas the greater portion of the small intestine lies sinistrally, much of the small colon is located to the right of the mid-line. The rectum is only a relatively straight and uncoiled terminal segment of the small colon.

The large intestine is noticeably longer by about twothirds than the small intestine.

Various myological observations stand at variance with the findings of Wood and White (1950) concerning certain muscles of the present species.

Microfilm \$4.55; Xerox \$16.20. 356 pages.

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